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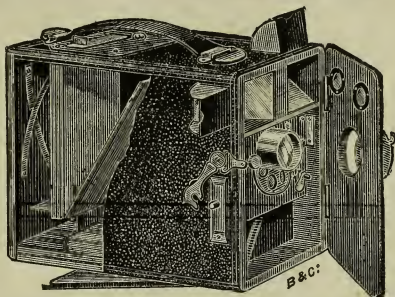
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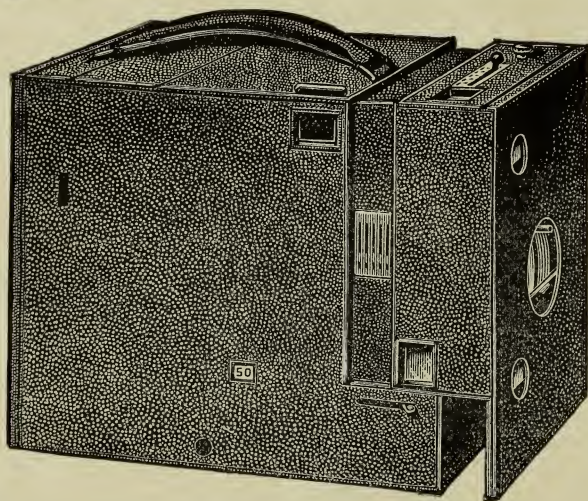
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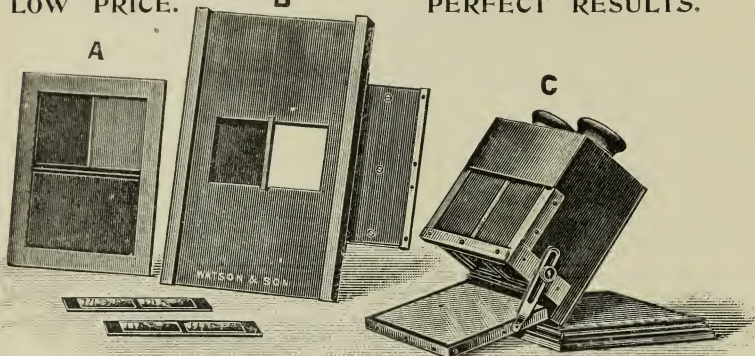
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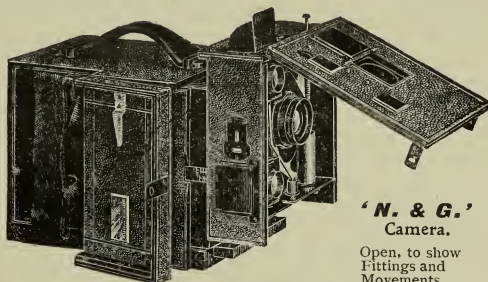
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AUTHOR OF "PHOTOGRAPHY FOR AMATEURS," "THE BOOK
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CHAPTER I.

INTRODUCTION.

"See, winter comes to rule the varied year."



Says the poet of the seasons, but winter is a variation of the year, in this country at least, which is, perhaps, only appreciated by poets, or by those hardy individuals who rejoice in a keen, cutting blast. As to these hardened ones, they drive, walk, skate, or engage in other outdoor exercises, and are able to look forward to the coming of the cold weather with the enjoyment which most people feel upon the approach of spring. The poets must be put in another category altogether, for they always see things *couleur de rose*. But the idea of colour connected with winter seems to be a misnomer, for everything is about as colourless as it can be. They sing, as only poets can sing, of the hoar-frost; the freshly drifted snow, which, because of its unsullied whiteness, is in their hands the type of everything pure; the hanging icicle; and they find beauty in things which to unsympathetic minds are suggestive only of damp boots and cold feet. But "rheumatism" and "catarrh" are awkward words for

poets to deal with, for they do not suggest poetical ideas, and what is more, they do not readily rhyme with anything in particular. It must be a hard thing for a poet to catch one of these disorders, and to feel that he has sunk down to the level of ordinary humanity, and must don a mustard plaister.

To photographers the coming of winter is indeed a melancholy time, for they love the sun, and the sun is seldom to be seen in our dull, damp English winter time. We must indeed envy our Canadian cousins, who know not of our troubles, unless, indeed, they are so ill-advised as to spend a winter in England. They are used to a sharp, cold atmosphere, with the thermometer lingering below zero in a way it never does here. But the air is dry, and they do not feel it; moreover, their houses are built in such a way that the cold air cannot get in, and the warm air is not wasted up the chimneys. So the poet's line, "All things that love the sun are out of doors," will hold good all the year round in Canada; but here in England the lovers of sunlight must stop indoors or pay for their temerity, excepting always those cast-iron individuals already referred to.

Although the amateur photographer is debarred from pursuing with the camera his ordinary course of work, there are certain opportunities for taking pictures which are only afforded during the winter time. I, of course, refer to hoar-frost and snow studies. But these can be undertaken only by the robust, and by those who have leisure and the means of watching their opportunity. For instance, the trees may be discovered some morning covered with nature's diamonds—in the shape of hoar-frost—but in a

short time the beauty of the scene has entirely disappeared. It is the same with snow ; it only looks its best for a limited time, and it is hardly worth taking a picture of it, unless the sun has begun to shine on its whiteness, and to make those pearly shadows which are so beautifully rendered by photography. So that the camera owner must be upon the alert if he wants to produce a picture under the best conditions. If he lose the chance, another opportunity may not present itself until next season.

But after all, such employment for the camera as that described is but fitful and uncertain, and can hardly be regarded as important. The modern amateur does not like to give up his hobby entirely for several months, and he will seize hold of such opportunities of practice with avidity, even though he suffer the penalty of developing his plates under still colder conditions. Luckily, there are other branches of his beloved art besides outdoor work, which can be practised by the modern amateur ; the outcome of various processes which would have been deemed impossible twenty years ago. At that time, it will be remembered, the old wet plate held the position which is now occupied by the gelatine process, and the wet plate did not allow of much modification. It had to be prepared by the photographer himself at the moment of using, for it would not last. Many endeavours were made to keep the film moist by means of glycerine, etc., so that the plate might remain long enough in the camera to take a dark interior without suffering deterioration. If the film dried during exposure it was spoilt, for the chemicals crystallised upon its surface, and rendered it useless. For this reason, coupled with the all-

important endeavour to do away with the dark-room or tent, and its contained bottles, experiments with dry processes came to be made, until they culminated in the gelatino-bromide process of to-day.

Winter is essentially the time for gelatine plate making by amateurs, for it is, owing to the putrefactive changes quickly set up in gelatinous solutions in hot weather, a most risky proceeding in summer time. The professional plate-makers are working all the year round, but they do so by the aid of special appliances which the amateur cannot command, and I believe that I am right in saying that risky operations are carried on in summer time, only in the early hours before the sun has asserted his power in too demonstrative a fashion. The amateur who wishes to excel, and at the same time to be thorough in his work should know how to make a good dry-plate. The details of working can be obtained from half-a-dozen good text-books, and therefore it is not my purpose to go over the old ground again. Moreover, I am convinced that only a small minority of workers will care to take the trouble to manufacture their own plates. They can buy them of the best quality, they say, and this is so true, and it forms such a good excuse, that no one can gainsay it. So that, although I regard plate-making with some affection, and look upon it as being educationally important to the modern amateur photographer, I shall not include it in my list of occupations to which in these chapters I wish to direct his attention. But there will be enough without it. Even in the expansion of the gelatine process itself, we at once find a wide field for active work, and work which is quite inde-

pendent of day-light. First, we have various methods of printing on papers which require only a brief exposure to gas or lamp light, the image being brought out by development. Some of these papers are capable of the very finest results, and there is no reason for doubting the permanence of those results. Next we have another adaptation of the gelatine process in bromide enlarging paper, which gives such excellent pictures. The best way of dealing with this new and valuable addition to a photographer's tools will be fully dealt with, and the apparatus which has been designed by various workers for its use will be considered. Lantern-slide making by various processes will naturally come under the heading chosen for these chapters, and some new methods of producing this valuable form of photographic picture will be fully detailed. Other processes which are possible to the amateur will not be omitted, and there are various subjects of great importance which will be dealt with in the succeeding pages. In an introductory chapter it is not always as well to say too much about what is to follow, for readers are naturally disappointed when they find that an author is not able to make good his promises.





CHAPTER II.

ON THE USE OF THE GLAZIER'S DIAMOND.



LASS has now for many years been the support of the photographic film. It came into use for this purpose with the wet collodion negative, which obviously must be supported upon a material which is transparent, or it cannot yield a positive print. Curiously enough, the flexible transparent material which is only now coming into use under the name of Celluloid was proposed for this same purpose long before the wet collodion process was thrust into the background by gelatine. But there was a very good reason why it could not then be adapted to the wants of the photographer, in that the solvents which were contained in the collodion itself acted upon the celluloid and immediately softened it. Any one who will take the trouble to try the effect of pouring a little collodion upon a piece of waste celluloid will soon see why it was that the proposition to employ those materials in conjunction was impossible of realisation. Now, however, that gelatine is employed, which is insoluble in

either ether or alcohol, and has thus no effect upon celluloid, the light and transparent substance can be spread with the emulsion with great advantage. It is certain, however, that glass will not and cannot be immediately displaced. Even were the supply of celluloid equal to the demand, the plate makers could not at once alter their machinery so as to meet the conditions under which this new medium must be coated with its sensitive film. Again, the professional photographers will not readily take up films for studio work, where the weight of glass plates, as opposed to celluloid, is a matter of indifference. For them glass plates are, for many reasons, more convenient than flexible films; and besides, there is the argument so potent with large users of plates, that they are much cheaper than films. This last consideration will also weigh greatly with the majority of amateur workers, so that we may feel certain that for a long time glass will hold its own.

It is an astonishing thing that so few amateurs take the trouble to inquire into the nature of substances which they are constantly using. One would think that glass should be in their hands a familiar thing, which they could cut and fashion to their needs in every way. But it is not so. There are many amateurs who do not possess a diamond, and if they did, would not know how to use it. They certainly place themselves under a great disadvantage in remaining ignorant of such an elementary thing as glass-cutting, because it is an operation that the amateur is constantly requiring. A negative may want trimming down to a smaller size, or waste glass may require cutting up into lantern slide cover glasses, etc. Certainly there are hosts

of purposes for which a diamond is often wanted, and unless the amateur can do the work himself, he must lose time by going to the nearest glazier's to do it for him. The alternative generally is to use one of those ingenious steel roller glazing tools, which can be bought for a shilling or less. These are useful enough when the glass is so thick that it will bear a good deal of pressure without breaking ; indeed, for thick glass I prefer it to the diamond, but for thin glass, such as photographers mostly have to deal with, it is a

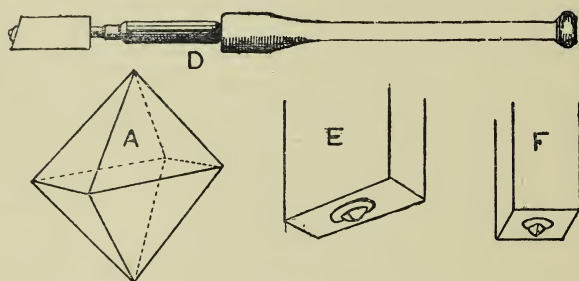


FIG. 1.

delusion and a snare. The diamond gives a much more delicate and cleaner cut, does not require any great pressure, and will, under certain conditions, to be presently stated, cut through the film side of a gelatine plate. A short description of the glazier's diamond will not be out of place.

The implement consists of a light wooden holder, shaped as shown at D in fig. 1, and measuring from top to base about seven inches. At its lower part is a metal block, which is so swivelled in the wooden handle that it will readily follow a defined course when moved against a

straight edge or ruler. This metal block contains the atom of diamond, or "spark," as it is called. The diamond spark is cemented into a tiny brass cell, which is held by a screw in the metal block. It is shown enlarged at E and F (fig. 1). The natural diamond, which is only a crystallised form of carbon, takes the form of a regular octahedron A (fig. 1); but the glazier's diamond is not necessarily of this perfect form. It is essential, however, that its cutting edge should be natural, and the result of cleavage. The sides which slope from this downward point are more or less convex, and there is no doubt that this wedge form tends to separate the glass as it is cut. Indeed, it is not unusual for the two halves of a piece of glass to drop apart of themselves before any breaking strain is applied by the hands. But it is generally necessary to complete the work begun by the diamond by snapping the glass between the fingers, or by applying pressure to one half, while at the other side of the cut the glass rests upon a flat surface.

The beginner will not find it easy at first to use the diamond, and he will notice that it slips over the glass without even scratching it, despite his endeavours to make it cut. The work requires constant practice, and with one particular tool—for each diamond has its angle at which it must be held, and it will not cut at all unless it is applied to the glass at that angle. The best way, perhaps, to learn how to handle the implement is to practice on a piece of waste glass which should afford a run for the diamond of quite twelve inches. Holding a flat ruler or T-square in the left hand, about half an inch from the edge of the glass, commence by making a light stroke from the farthest

point towards the body, holding the diamond almost upright. There will probably be no cut. Now repeat the operation, only slope the diamond towards the body, so that it is slightly out of the vertical. Slope it more and more every time, until you feel that it bites the glass. When it does this, more than half the difficulty has been surmounted, and you will soon be able to make an effective cut. But even when this correct angle is achieved, it will require practice not to deviate from it during the continuance of a long cut,

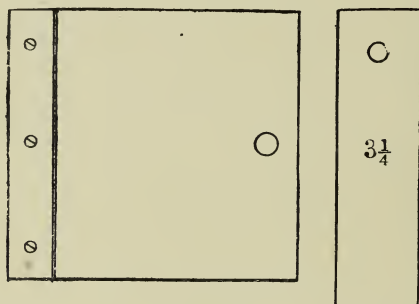


FIG. 2.

for there is always a tendency to raise the implement towards the vertical as it is approached towards the body.

In photography, glass is used in certain standard sizes, and the cut required has generally to be made at a right angle. A simple form of cutting block, like that shown at fig. 2, will be found of great use. It should be made of stout wood, so that it will not warp, and the ledge shown at the left-hand side should be screwed to it in a direction across its grain. I need hardly say that this cutting board must be perfectly squared, or the glass cut upon it will be

askew. Associated with it are certain flat forms or rulers, of various sizes, and with a hole through the end of each, so that it can be hung upon the wall on a nail when not in use. One of these forms is shown at the side of the cutting block. It is plainly marked $3\frac{1}{4}$, for its purpose is to act as a guide for cutting out lantern plates, which measure $3\frac{1}{4}$ by $3\frac{1}{4}$ inches. Supposing, therefore, that we had a piece of glass measuring $6\frac{1}{2}$ inches square, we could, by means of this gauge, separate it into four lantern-slide glasses by two cuts with the diamond. But let it be noted that the form or ruler must be somewhat short of the measure marked upon it, so that the space between the point of the diamond spark and the side of the metal block in which it is set may be allowed for. Otherwise we should find that every piece of glass cut was about one-sixteenth of an inch larger than it was required to be. I say one-sixteenth, but as a matter of fact diamonds vary in this respect.

Mr. Cowan has devised two very perfect forms of cutting boards, which he has patented, and which are made by Messrs. Marion and Co. The first is designed to instantaneously centre a piece of glass by means of a clamping frame, after which a hinged straight-edge is brought down upon it, the edge marking the exact centre of the glass. The convenience of the arrangement will be appreciated when it is remembered that in many cases the larger sizes of photographic plates form, when divided into two or four, the smaller sizes. There is an unfortunate exception in the case of the half-plate, for it is more than half a whole-plate. But a whole-plate will cut into four quarter plates, and a 10 by 8 into four 5 by 4. Mr. Cowan's contrivance

is, therefore, a valuable one, and more especially because it can be used in the dimmest of red lights, for the plates submitted to it centre themselves automatically. It is shown at fig. 3. It measures about 22 by 17 inches, and consists of a strong board, upon which is placed a movable frame, of which *b b* are the two upright sides. This frame is loosely rivetted at each corner by a screw, but is only

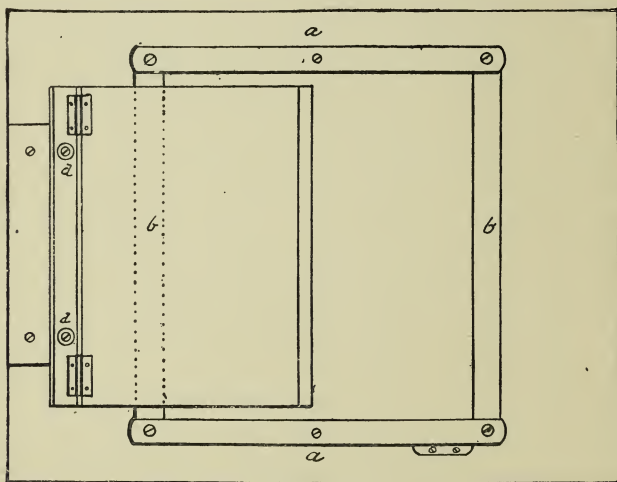


FIG. 3.

attached to the base-board by the two central pins on its top and bottom pieces, upon which pins these pieces are free to turn. It is evident that if these top and bottom pieces be turned on the screws, they must come oblique to the board, and at the same time the uprights *b b* will, while remaining strictly parallel to one another, be brought nearer together. This to and fro movement of the uprights *b b* allows a glass plate of any size, within the limits of the

frame, to be clamped between them. The centre of the glass plate must, however, always lie in an imaginary line between the screws *a a*. At this part, therefore, a hinged board has its termination, and is bounded here by a bevelled straight edge, along which the diamond is guided, cutting the plate exactly in half. Two screws on the left-hand side of the board *d d*, having brass washers beneath their

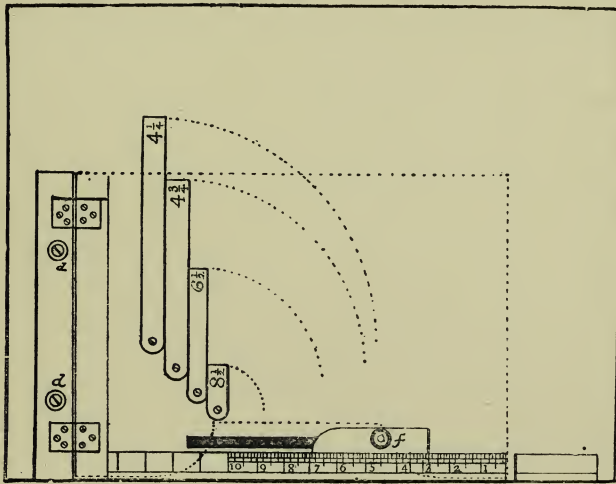


FIG. 4.

heads, are placed in elliptical holes, so as to allow the hinged board to be adjusted to suit different diamonds. The necessity for this adjustment has already been indicated.

Mr. Cowan's other cutting board is more elaborate, but will cut plates readily to all the standard sizes, and by slight adjustment will form a cutting gauge for any odd size which may be required. It is shown at fig. 4. In this case we also have a base board, with another one which

can be raised or lowered upon it by means of hinges. The outer edge of this latter is described by the vertical and horizontal dotted lines, and it will be understood that its right-hand side forms a bevelled straight edge for the diamond, as in the former example. This cutting edge can, too, be adjusted once for all to suit the width of the block in which the diamond is mounted by means of the screws on the left-hand side shown at *d d*. Lifting up the hinged board, we find four gauges in a vertical position, but which in use are bent down to the horizontal, as indicated by the curved dotted lines. By their aid we can cut quarter plates, half plates, or whole plates at will. At the lower part of the board there is an inch scale, and just above it is a slot, in which works a movable block having a set screw *f*. It is by means of this block that a gauge to any size can be readily procured. But the principal use of the instrument is seen in the employment of the standard gauges, and in the dim light of the "dark" room such a contrivance becomes a necessity. In the case of cutting through a dry plate it may be cut from either side, but it is best to apply the diamond to the film side. There is more than one reason in favour of this course. If we make our cut on the back, that is, on the glass side of the plate, we are pretty sure to raise a few tiny filaments of glass which may lead to scratching of the film subsequently; we find, too, that when the cut is made in this manner, and the glass is broken into two halves, it still remains united by a tough hinge of gelatine, which cannot be parted without some effort, and which will often lead to partial stripping of the film. But by cutting through the gelatine in the first instance, this last difficult

cannot arise, and there will be no spicules of glass to cause after-scratches of the film.

But a difficulty arises in the circumstance that all glaziers' diamonds will not cut through gelatine. Mr. B. J. Edwards tells me that it is his practice to send to the manufacturers for a number of diamonds at a time, and to try them one by one, so as to sort out the minority which will cut through a glass plate on the film side. He tells me that a diamond which will do this, and one which will not, do not differ in appearance in any way, even when subjected to the closest scrutiny. The only way of finding out the right kind is by careful trial, and not by mere examination.

Common sheet glass is never quite flat, and when we consider the process by which it is made, it is easy to see why this should be the case. The glass is first blown by successive stages to a cylindrical figure. This cylinder is then cut down longitudinally, and while it is left to soften upon a table under the heat of a furnace, it gradually unbends, and falls flat by its own weight. Plate glass, on the other hand, presents a true surface, for it is produced by quite a different series of operations. It is cast glass in reality, for the soft mass is poured upon a table, after which it is traversed by a heavy roller, and finally ground and polished. These latter processes reduce its mass by about 40 per cent. Messrs. Chance, of Birmingham, were the first to apply this polishing process to sheet glass of selected quality, and it is this glass that should be used, if procurable, for all photographic purposes. It is known in the trade as "patent plate," and although it is far more expensive than common glass, it possesses advantages which make it worth its cost. Among these qualities

are smoothness, flatness, and freedom from striæ and other imperfections. It is, therefore, as well to work on patent plate if we require a sheet of ground glass, as this will much lessen the labour, and the beauty of the result will be enhanced.

The grinding of a small piece of glass is by no means difficult, and the amateur photographer should know how to do it. The glass is fastened down on a wooden table, or work-bench, between fillets of wood of the same thickness. It is now plentifully supplied with a mud made of flour-emery and water, and is rubbed continuously either with a small piece of thick plate-glass, or with a piece of flat tin plate with a handle attached. Every now and then the glass should be lifted from the table, washed under a tap, and examined. If any clear spaces are left, the rubbing operation must be renewed until they disappear and an even ground surface is obtained. By this simple means a grain of exquisite fineness can be secured, and one that is eminently fitted for the purpose of focussing.





CHAPTER III.

HINTS WITH REGARD TO APPARATUS FOR LANTERN-SLIDE NEGATIVES.



THOSE who are anxious to devote themselves to lantern slide production, and who have not yet possessed themselves of photographic apparatus, or who have perhaps been in the habit of producing pictures measuring 12 by 10, or even larger, will be anxious to know what is the most serviceable kind of camera to adopt for this special class of work. I have no hesitation in recommending the quarter plate as being the most useful size for lantern work. Most amateur lantern pictures are now produced by contact with the negative, and therefore this negative should be of the same size, or about the same size, as the lantern slide to be obtained from it. The standard size for the lantern picture is $3\frac{1}{4}$ inches square; this is a comfortable size in many ways, and is certainly not likely to be altered; for it is convenient both to the camera worker, and is suitable to the instrument by which when finished its image is to be projected upon the screen. As the quarter-plate measures $3\frac{1}{4}$ ins. by $4\frac{1}{4}$ ins, we have an inch to spare

at one side of the plate, and as most landscapes will be taken so that the spare inch is at the sides of the picture, it gives us a certain amount of horizontal latitude in printing our lantern picture from it. What I mean is, that we can from such a negative, by shifting the lantern plate upon it from side to side, choose the very best portion of the picture. We also have to some extent latitude with regard to the picture vertically ; for although the negative will only measure this way the exact size of the lantern picture, yet, as the upper portion of the negative will represent the sky, we can easily shift the picture a quarter of an inch or so if required ; for the clear glass representing sky can readily be secured above the actual negative, by pasting upon it a little slip of dark paper ; or we can secure the same end by shading the upper part of the negative during exposure. The question of printing-in clouds from a separate negative will for the present be reserved.

For ordinary straightforward landscape, the simpler form of camera that we can obtain the better. If the depth of our purse is not limited, the best course is to buy a first-rate camera with all the movements which such instruments possess in the way of swing-back, rising front, and so on. Such a camera will be serviceable for all kinds of subjects. But if the question of cost must come in, the worker will find that he can take first-rate lantern pictures with a very much simpler form of apparatus. The movements to which I have just alluded, although most desirable under certain circumstances, are really not very often brought into play ; and if our intention is to confine ourselves to pure landscape, they can very well be dispensed with. If we are

taking street views, or including architectural subjects in our pictures, it is a different matter, for in such cases it is often necessary to tilt the camera; and directly it is thus tilted out of the horizontal position, the straight lines of any buildings that may be in front of it are immediately caused to converge in a very unpleasant manner, and this converging of the lines must be corrected by the judicious use of the swing-back. But however simple the form of the camera, it should be provided with a bellows giving long extension; so that long-focus lenses can be used as well as those of shorter focus. We shall presently see that this provision will give us extended powers.

Although we may be careless to a certain extent as to the kind of camera we employ, we cannot be too particular in the lenses which we attach to it. Very good work can be done with that cheap form called a "single lens," and for landscape pure and simple it cannot easily be beaten; but it has certain faults—faults which, however, are generally very much exaggerated, and which frighten many workers from using it. It gives a certain amount of curvature of straight lines, but these lines only get bent to any visible extent when they are at the margin of the picture; and such curvature in pure landscape may be disregarded entirely, for practically there are no rigidly straight lines in nature, if we except the horizontal line which marks the distance in a seascape. Mr. Dallmeyer has recently introduced a new form of single lens, which gives straight lines, and there is little doubt that this form has a great future before it; but the old form of single lens, on account of its cheapness, is too often regarded as being good for nothing, but, as we have

seen, it will do very good work, so long as it is confined to landscape. Another disadvantage which it has is its comparative slowness, so that what are called instantaneous pictures cannot be taken by its aid unless the light be better than it often is in this country.

There is no doubt that the most useful all-round lens for this and other photographic work is that known as the rapid rectilinear, or rapid symmetrical, for it will take landscapes, architectural subjects, groups, portraits of small size, and instantaneous pictures. This form of lens consists of two achromatic combinations, with their concave surfaces facing one another, and the diaphragm aperture being mid-way between the two, and it is perfectly free from the faults possessed by the single lens. Moreover, it can be used on occasions as a single lens by removing the front combination and using the back one alone. This combination will then act as a single lens, giving an image which is far larger in size than that given by the complete lens. This power of transformation will be found most useful, and really affords the operator all the advantages which would accrue from working with two lenses of different foci. For instantaneous work the lens must be provided with a shutter of some form, but it would be impossible, in the limits of these articles, to detail the various kinds which are now offered by manufacturers. The simple drop shutter is by no means to be despised, for it will do good work, does not readily get out of order, and is cheap.

The worker will do well to provide himself with another lens of short focus. That known as the portable symmetrical or wide-angle form is one of the most useful ; it is not

a quick lens, but does admirably for copying purposes, and for taking interior views with long exposure. The possession of a short-focus lens, too, will be found useful. On occasions the operator may be so placed that when he views the picture on the ground-glass focussing screen it appears far too large for the limits of a lantern slide. Thus, for instance, he may be wishful to take a photograph of a church, and the only point from which a satisfactory view can be obtained is from a corner of the churchyard. His camera is erected there, but he finds upon examining the ground glass that only a small portion of the church is taken in. He cannot move back so as to reduce the scale of his picture, for the space is confined, so that he must either take a limited view or give up the attempt. But not so if he be provided with a short-focus lens, which by the way should screw into the same flange as his other lens. The former is quickly substituted for the latter ; the camera is racked in, so as to accommodate itself to the shorter focus of the new lens, and upon looking at the ground glass the operator finds to his satisfaction that the whole of the building is included.

And now, for the sake of showing the use of the rectilinear as a single lens, let us imagine that the case is reversed. The operator is standing at the edge of a river, upon the opposite bank of which stands a building which he wishes to photograph. Here the short-focus lens would be quite out of place, for the building would be reduced to so small a size that the picture would be useless. He then tries how it looks with his rapid rectilinear ; now he finds that the picture is a good deal bigger, but still too small

to be effective. Thereupon he unscrews the front lens from its mount, places a small stop in the diaphragm slot, racks out his camera to double its former length, and he sees now that the ground glass is fully occupied by the coveted image. It is not my purpose to recommend the lens of one maker above that of another, for there are now plenty of good ones to be had. But what I urge most strongly is that the purchaser should get as good a lens as he can afford. Photographic friends will tell him what to buy, if he will only state the amount of money that he can expend upon this most important part of his photographic apparatus.

Those who employ a quarter-plate camera are relieved of several inconveniences which beset the worker with apparatus of larger size. The whole kit is so compact and has such little weight that it can be carried everywhere, and can often accompany its owner on expeditions connected with his business, packed away in some corner of his portmanteau, into which a larger sized camera could never be squeezed. But there is a still greater advantage found in the circumstance that there are many clever devices for changing plates which can be well applied to the quarter-plate camera, but which become cumbersome when fitted to the larger sized instruments. Take, for instance, the oldest, and perhaps the best form of changing box—Hare's. It holds from twelve to fifteen plates, and each one in turn can be placed in the dark slide, in bright sunlight, without any chance of light fog. The weight of the box when filled with plates is insignificant, but apply the same treatment to the half plate size, and the thing at once becomes a burden. The same reasoning will apply to nearly all changing

systems, and at the same time we must remember that a large number of plates is not always required. On many occasions a couple of plates, contained in an ordinary double back, are sufficient for the particular purpose in view, and, therefore, I would recommend any one adopting the changing-box system to take care that double backs can be used with the camera when necessary.

So far I have supposed that the operator is contemplating the use of gelatine *plates*, but of course we must not lose sight of the circumstance that many will discard glass in favour of celluloid. Certainly, all will not do so, for questions with regard to cost both of the films and alteration of apparatus will have to be considered ; and for a long time we may feel sure that glass plates will be used by the majority of workers. At the same time those to whom expense is no object will substitute the new method for the old, and will gladly exchange heavy glass for light celluloid. The difference in weight will, however, not much affect the worker with quarter-plates, and, therefore, the searcher after negatives for lantern slides can in this matter well afford to take up a neutral position.

All photographic beginners have a notion that they must go in for what are called instantaneous pictures, and they think that they have only to get a camera and they can at once secure pictures of express trains, horses racing, and all sorts of pictures showing quick motion. It is true that such pictures are taken, but not by beginners. It requires a very great experience and a worker of the first class to turn out satisfactory pictures of this kind ; and so we would advise the beginner to practice

for a long time with the ordinary form of camera before he attempts these instantaneous effects, or else he is likely to suffer great disappointment. He may be tempted to buy what is known as a detective camera—a better name for which is the hand camera, for detective cameras seldom detect anything. It is a most useful instrument for certain purposes ; for little studies at the seaside, on the beach or of passing vessels at sea, it can hardly be excelled ; but it cannot be used satisfactorily except in the best of light. Perhaps in the near future we may have quicker lenses, quicker plates, or, what is far more likely, more developing power, and then the field of work covered by these hand cameras will be very much extended. But at present a good light, if not actually sunlight, is one of the first conditions of success. I have had a good deal of experience in the use of these detective cameras, and a short time ago I published a few notes embodying my notions respecting them. As I have found no reason to alter my opinions, notwithstanding the fact that I have since had unusual opportunities of working with various forms of this instrument, I will here give a short summary of what I then wrote concerning it.

As a convenient method of obtaining snap shops under good light the detective or hand camera is unequalled, and will for such work displace the ordinary camera. As a rule, hand cameras are far too elaborate, and many of their usual adjuncts can be well dispensed with. The lens should be of such a type that everything beyond a given distance is in focus, so that no focussing movement is wanted. A finder is also unnecessary, for while the operator is examining

it he will perhaps lose an opportunity which he would otherwise at once take advantage of. The shutter should have two speeds, one for street views, and a far quicker movement for seascapes and open views where there is no dearth of light. The camera should be capable of taking the plates as they come from the makers—that is to say, they should not require insertion in sheaths. The plates used should be both quick and of good quality. There are a few detective cameras in the market which meet some of these conditions, but the absolutely perfect instrument has not yet appeared.

Referring again to the more ordinary work of the photographer, it must be conceded that a negative for reproduction as a lantern-slide must be without flaw or blemish, for magnification will quickly draw attention to everything of the kind. Some otherwise good lantern pictures which I have seen have been quite spoilt by halation. In its more aggravated form halation is well known to everybody who has ever looked at the photograph of a church interior. It will be noticed that all openings next the light are surrounded by a kind of halo or fog; and that the details in the windows themselves—that is to say, the bars, the tracery, and the leads which divided the panes of glass—are altogether blotted out in a white mist. The same effect, in a minor degree, is often noticed in outdoor scenes; the tops of the houses in a street view sometimes seem to be in a misty condition, and the chimney pots, instead of standing out clear against the sky, are also very dimly defined; the same thing can be noticed very often in the tops of trees. This defect, which makes its appearance

whenever bright light comes against the dark portion of a picture, is known as halation, and is caused by reflections from the back of the glass negative plate. A negative having this defect should not be used for lantern-slide work, for it is quite impossible to get a perfect lantern-slide from a negative which is itself imperfect. The only satisfactory cure that I know of is at best a makeshift, but it is effective, albeit it requires a little time and patience. Suppose that we have a negative which shows this fault, the best way to proceed is to remove the varnish from it—if it has already been varnished—by immersing it in warm methylated spirit, and rubbing with a tuft of cotton wool, and then to rub the dark portions of the negative which exhibit this fault with a piece of old linen, stretched over the finger, moistened with alcohol. The work must be done judiciously and gently, and we shall soon find that the linen over the finger becomes black, showing that part of the gelatine surface has been actually removed. We then shift the finger to a fresh portion of the linen, moisten once more with spirit, and proceed as before, until we find by holding the negative up to the light that the darkness has been to a great extent removed. But, of course, prevention is always better than cure, and, luckily, prevention in this case is easier than cure. If we are using glass plates, we can stop halation by giving the back of the glass a coating of colour, by means of a brush or a piece of sponge, but a better way was recently brought before the Photographic Club by Mr. Carter, who showed how a number of plates can be thus coated on the back with a small composition roller, like that used by a

printer ; no doubt an india-rubber roller would answer the same purpose, and such rollers are now sold at the photographic warehouses for mounting prints. The best material for backing plates is burnt sienna, ground in water, which can be bought at oil shops. A small piece, the size of a nut, is put on a sheet of glass, and to it is added a little water, a few drops of spirit, and a pinch of dextrine. This mixture forms a cream-like mud, and the roller is worked upon it until it is evenly distributed over the sheet of glass. The plates are now to be treated one after the other—of course, by the red light of the dark-room—and in a few minutes they will be dry and ready for the camera.





CHAPTER IV.

ISOCHROMATIC PLATES FOR LANTERN-SLIDE NEGATIVES.-- AMATEUR LECTURERS.



HAVE detailed a few methods of rendering a plate free from the troubles caused by halation, because I know them to be effective. But the worker must be warned against employing any pigment of a powdery character, which may get abraded by the spring at the back of the dark slide, or by friction in any of the numerous forms of changing bags, boxes, or backs. Should the apparatus become charged in this way with floating particles, they are very difficult to get rid of, and will lead to pin-holes, if not to worse manifestations of their presence.

Some makers are meeting the halation trouble by issuing plates which are treated on the back surface with a fine grain. I have used plates so ground, and have found the resulting negatives perfectly free from halation. Upon one occasion I photographed a statue—black and grimy with London smoke—and standing up against the blue sky in a manner which would have invited halation under ordinary conditions, but my negative was perfectly free from any-

thing of the kind, although the exposure was long enough to coax detail out of the gentleman in black—I mean the statue. It must also be borne in mind that film negatives are altogether free from this fault, and may with advantage be employed in cases where halation may be reasonably anticipated.

Before I dismiss the question of negative making for the purpose of lantern-slide production, it is as well that I should allude to the use of colour-sensitive, or isochromatic, plates. Some prefer to call them “orthochromatic” plates, but we need not discuss the suitability of either term, for as a matter of fact neither exactly describes the thing intended, one word meaning equal colour and the other right colour. We all know now that these plates profess to translate colours in their correct tint value to one another, using the word tint, as an engraver employs it, to define a shade made up of certain proportions of black and white. The value of such an innovation is evident when we remember that ordinary plates will transform blue into white, reds and yellows into blacks, and so on. So that anyone who tried, say, to photograph a sunset picture, in which an artist had painted a blood-red orb, hung in an orange sky, would find in his copy a black ball poised against a background, only less dark in tint. For such work, as also for the right rendering of natural flowers, such plates are almost indispensable. I say almost, for I believe that ordinary plates, used with a proper yellow screen, and with extended exposure, will give much the same effect. But what is of more importance in the present connection is the consideration whether, for ordinary landscape, there is

any great advantage in using these colour-sensitive plates. In order to put this matter to fair experimental proof, I have tried the effect of photographing the same landscape, first with an ordinary plate and afterwards with one which was colour-sensitive. These experiments were made in the early spring, when the foliage was fresh and varied in tint. Upon examining the negatives taken under these conditions I found little difference between the two varieties, with the notable exception that in those taken late in the day, when the sun was bathing everything in a warm orange light, the isochromatic plates exhibited double the detail which the others afforded. I was therefore led to assume that in such light as is available during the greater part of the day isochromatic plates give no special advantage. But I altered my opinion as soon as I had time to examine the prints from the two sets of negatives. It was then that I recognised for the first time that the isochromatic negatives were far richer in tint than the others, and possessed a beautiful softness which was absent in the negatives produced on the ordinary plates. To borrow a simile from a sister art, I might say that the negatives on ordinary plates were diatonic in character, and that most of the intervals were separated by whole tones, and that in the isochromatic plates the tints were not so widely separated, but exhibited the greater wealth of the chromatic scale. The plates I used were Edwards's, and I may further say that for instantaneous work they are as quick, and as satisfactory in every way as any that I have tried.

The lantern season being now well established, a great many amateurs are busy slide making, and perhaps some

are contemplating an exhibition of their handiwork before a more or less indulgent public. I have had many enquiries from some of these ambitious showmen *in embryo*, but some are more modest in their demands than others. There is the ingenuous youth, who plunges at once *in medias res*, and boldly proposes that you should consent to lend him your apparatus and slides; and there is also the self-confident being who says that he is about to give a lecture, that he has never given one before, and would be glad of a few hints. These people always remind me of the man who when asked whether he could play the violin answered that he did not know, for he had never tried. To such a one let me now address myself, and tell him that successful lecturing is not a thing that can be acquired easily, that it not only requires constant practice and experience to speak effectively before an audience, but that the speaker must have the physical advantage of a good voice, and must have other capabilities which some men possess as natural gifts, but which can seldom be acquired. However, audiences are indulgent, and do not look for perfection. And the amateur lecturer may take heart that he will be listened to attentively if he will only take pains to make himself heard. He must also be careful to see that his lantern pictures are in such order that none of them will appear "topsy-turvy" on the screen, and that he has an assistant with sufficient intelligence to get through the work without mishap.

All amateur lecturers should read the account of a dissolving view entertainment which forms one of the chapters in Albert Smith's "Adventures of Mr. Ledbury." Albert

Smith being himself a good showman, was well able to see the comic side of a badly managed lantern evening. And, to tell the truth, there is not much exaggeration about it. An amateur lecturer has undertaken the task of describing the views, and has unfortunately lost his list of the pictures shown, a loss which soon involves him in serious difficulties. The first view is described as "The Harbour of Chusan," while it plainly shows the windmills and other well-known features of Margate. Then comes a view which appears to the operator, as he looks through the slide before it is placed in the lantern, to be "like some fortifications and a tower." The lecturer gives it out as the "citadel and ramparts of Ghuznee," but the view is not in Afghanistan at all, but is one of "Windsor Castle"—a circumstance to which attention is at once called by a sharp youth among the audience. Then, besides, we have a picture of Prince Albert standing on his head; a view of Milan Cathedral, which the lecturer describes as "The Houses of Parliament at Westminster;" and many other amusing cases of misnomer.

But, truth to tell, such gross mistakes are not often met with now. The lantern has become such a familiar instrument, and is made in such convenient form, that it is really not easy to go wrong with it, at least when one of simple form is in question. The weak part of such an entertainment is still found in the man who does the talking. Sometimes he is far too confident of his own powers to take the trouble to make himself familiar with the pictures shown. He borrows from an optician a published reading—a very sensible proceeding on his part, by the way—but takes no care to compare the reading with the pictures which illus-

trate it ; so that if the operator should lag one picture behind the reader, or put in one too soon, the mistake goes on from beginning to end, and the intelligent lecturer is describing either a scene that is past and gone, or one which has not yet made its appearance. I need hardly say that such confusion is fatal to success, for each picture should come into view as it is mentioned ; and some tact is necessary in the arrangement of the words, so that the entry of each shall be natural and effective. As the novelist or the playwright will skilfully lead up to the introduction of his various characters, so should the worker with the lantern take care that his pictures are brought on with appropriate words. I will presently enter more fully into the details of this most important part of our winter work.





CHAPTER V.

ABOUT LANTERN ENTERTAINMENTS.



HAVE already promised to devote some space to this subject of exhibiting lantern pictures, and I am now about to fulfil that promise by placing before my readers a few directions which may help them in their efforts to amuse the British public. I have chosen from my detective pictures a few which will serve to illustrate the method in which slides can be advantageously strung together with a few suitable words, so that they may appear as a complete whole, rather than as detached items having no kind of connection with one another. There is to my mind nothing more irksome than sitting through an exhibition of lantern pictures where the showman has not the opportunity or the power of giving more information concerning them than their mere names. This is frequently the case at the lantern shows of amateur photographic societies, and, except to those who are interested in the technical points of the pictures, such exhibitions are wearisome affairs. If, on the other hand, the slides can be sorted into some kind of order, with similar subjects placed together, and the whole bound

up with a few appropriate remarks, with a joke or two inserted judiciously as "high lights" in the right places, the pictures will be made interesting to all the spectators, instead of, as at present, to a limited few. I cannot expect my readers to regard what follows as a model discourse, but it is the kind of thing which gives pleasure to a general audience—as far as one can judge by hearty laughter and applause, and is put forward as a peg upon which pictures of a certain class can be hung. I have placed the matter in the form of a letter which a visitor to town, fresh from rural scenes, writes to her cousin in the wilds of Blankshire.

Morley's Hotel,

Charing Cross, London,

Thursday.

(B¹) 1.

MY DEAREST MAGGIE,—As I promised, when I left Turnip-ton with Uncle James, to write to you about my first impressions of this big village of London, I now take up my pen to begin. You will notice that I date from Morley's Hotel, which is in Charing Cross, and you will be somewhat surprised to see that I head my letter with a photograph of it, and that many other pictures adorn my epistle. The fact is that I have been obliged to make



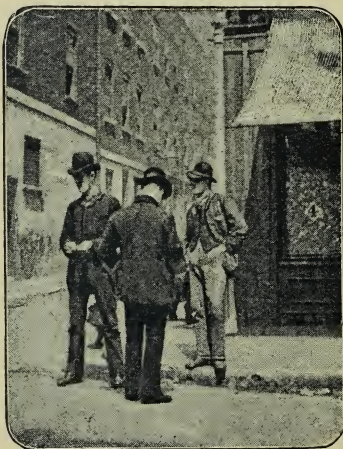
(1.)



(2.)

to by different men. Uncle said that they were stock-brokers—they had a plentiful stock of impudence, any way. He made me leave off, and, as some compensation for his interference, gave me what they call a Detective Camera. This is really a most wonderful little instrument. It looks just like a little work-box, but it contains all the things necessary for taking a photograph secretly, and with its help I am able to take all kinds of subjects without anyone knowing

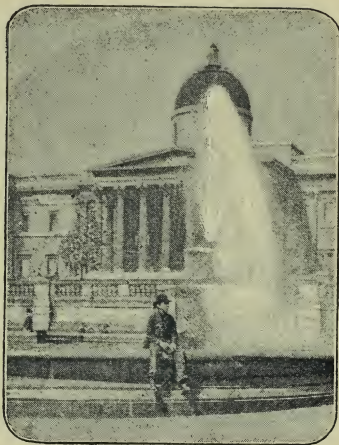
one slight modification with regard to my promise to you, that I would send you sketches of what I saw. I tried to do some, but you have little idea how rude the people are here, and how they stare at and crowd round you, if you attempt to do even a little drawing. I tried to do one the other day close to the Royal Exchange, but was continually laughed at and spoken



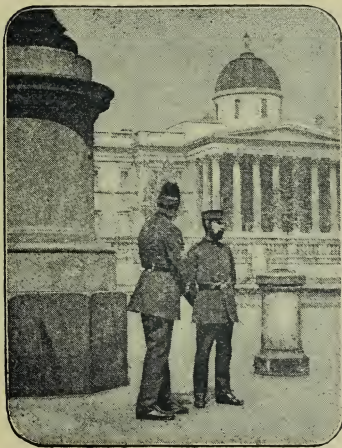
(3.)

what I am doing. It is such fun taking people's portraits without their knowing anything about it. I have been all over London with Uncle James, to see everything that is to be seen, and I am always accompanied by my faithful witness, the detective camera. The most remarkable thing to a stranger, in walking through the streets of this prosperous city, is the

way in which affluence is seen side by side with abject poverty. Look at this picture (B^2), for instance, which was

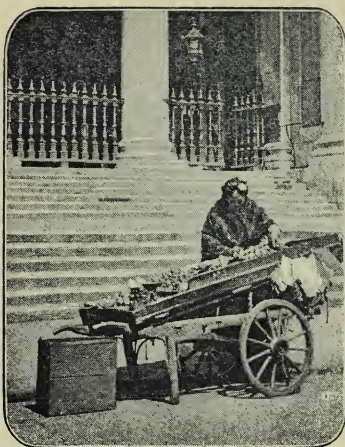


(4.)



(5.)

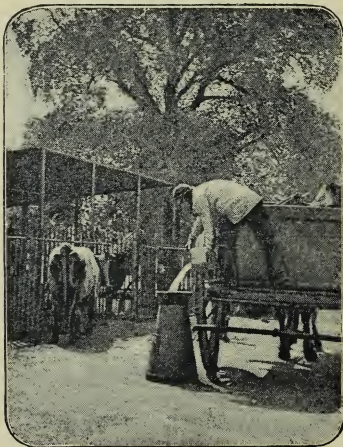
taken in the West-end, or fashionable part of London, just outside Kensington Gardens—this is where the big houses and grand footmen are to be found—and compare it with this next one (B^3), which was taken in the slums. These are loafers standing at the corner of an alley in Drury Lane. Drury Lane is well known because of its handsome



(6.)

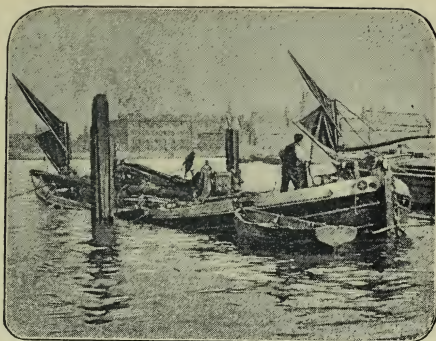
though—sitting disconsolately, and swinging his legs on the side of one of the fountains (B₄). (Uncle James says that these fountains play from ten till four, like the Government clerks. Isn't he dreadfully sarcastic?) But there were a number of policemen about to see that the small boy did not set fire to the fountains or begin an insurrection. One policeman, a big one, was talking to a rather diminutive inspector (B⁵). It would clearly be impossible in this case for him to

theatre, which is the only handsome thing about it. It is not very far from Charing Cross, where the riots were some time ago, and upon which the windows of our hotel look out. On my first survey of Charing Cross I expected to see some advanced Radical haranguing a large Socialist mob, but there was nothing of the kind, only a small boy—perhaps a Socialist,



(7.)

look *up* to his superior officer. In a corner of Charing Cross there is St. Martin's Church ; "St. Martin's-in-the-fields," they call it, but the fields are conspicuous only by



(8.)

their absence, and there is no sign of agriculture but that old woman selling the fruits of the earth (B⁶)—in this case apples and ginger beer—from a barrow. Then at the opposite corner of the Square is "Spring Gardens," so called, uncle says, because the Board of Works, who



(9.)

used to live there, had lately "been *sprung* upon," but I don't quite know what he means. Spring Gardens is in reality a passage leading into St. James's Park, and just at the point where it opens into the park some cows are kept. Uncle says that the reason for this is that the members of the Board liked to see from their windows some evidence of rustic simplicity. Was it

not nice of them? But I was rather staggered to see a man with a water cart (**B⁷**) spooning water by the gallon into a milk can. Look at my picture! I just caught him with my detective camera when he was in the very act. I appealed to uncle, and he told me that he thought it might be to mix up white-wash for the Board, who required a lot of it. But if this means adulterated milk, I am sure that some kind friend should have told them how shamefully they were being imposed upon.

Talking of water, we went to the river—the River Thames. You remember how we learnt at school that London is on the Thames; well, it *is* so.

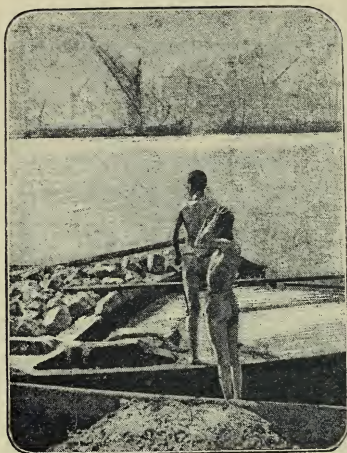
A penny steamboat ticket takes you for quite a long journey. There is much to see, and sometimes you can get a little group of barges (**B⁸**), which are wonderfully picturesque. But the water is not so clean as it looks in my picture. Uncle says it is full of “microbes,” but I must confess that I did not see any. There are piers at frequent intervals and the people crowd upon them to get into the boats (**B⁹**). We landed at Lambeth, where the Archbishop lives, and close to the pier some big boys were taking “headers” from a barge. Here uncle sent me on before him (**B¹⁰**), and he borrowed my camera, with which he took my next picture. I didn’t do it, mind. We passed through some really dreadful neighbourhoods, where uncle did not like me to stop long enough to take pictures. In one street some babies were amusing themselves without any kind of protector (**B¹¹**). In the same street I actually saw a miserable five-year-old girl in rags, carrying a ragged baby, a tin of beer, and a bottle of gin. Isn’t it awful?

One's heart bleeds for these poor little waifs. What is to become of them? How different are their pallid faces and rickety limbs from the healthy, sunburnt, and fat little bodies that we see running about the fields at Turnipton!

Yesterday was the day after Bank Holiday, and we came upon this curious group (**B¹²**) just outside Bow Street Police Court. Uncle told me that the friends of these unfortunate people had probably got intoxicated (horrid things!), and were at that moment being tried for their offences. The sympathetic policeman is telling the women what the punishment is likely to be. I call this picture "Waiting for the Verdict," and although it is not so artistic as Solomon's well-known work with the same title, it is reality, and not romance.

I have so many photographs now, thanks to this detective camera, that I hardly know how to select from them those that you will think interesting. Here is one (**B¹³**) taken in Leicester Square. In the centre is a statue of Shakspeare, with three workmen carefully washing him. It seems that this is necessary, because some American has been throwing a great deal of dirt at him lately; at least, so says my informant, Uncle James.

And now I must say good-bye, for this letter is getting dreadfully long. I have much to tell you upon the important subject of dress, but must reserve my important information, gleaned in that world of delights called Regent Street, until we meet. In the meantime my last little picture will tell you that what uncle calls "those ridiculous monstrosities" (**B¹⁴**) are still worn, although it is



(10.)

believed that they will presently be out of fashion.

With best love,

Your affectionate cousin,

JULIA.

P.S.—The building on the right of Shakspeare's statue is the Alhambra, and is quite an architectural feature of London, and is a model of the Spanish Alhambra. Lots of people go there, but when I have asked uncle to take me there, he always makes some excuse.

In perusing this little sketch of a lantern entertainment the reader will notice that the text is frequently interrupted by the insertion of a big **B**. This is meant to indicate the point where the reciter must touch his gong or other signal, so that the operator at the lantern may change to the next picture. The signal should in every case be given a few seconds be-



(11.)

fore the picture is actually required, so as to allow time for the necessary manipulations.

Another point which cannot be too urgently insisted upon is the necessity for the reader to thoroughly know his subject beforehand, and to be acquainted with the pictures which illustrate it. He should, in fact, carefully study the text, while

at the same time he examines each picture as it comes in order, so as to find out all its points, some possibly which have been overlooked before.

In this way alone can he make his remarks effective and interesting to his audience.

Eloquence is a natural gift which no amount of study can command; but a study of elocution is both advantageous and desirable; and this study can be had for nothing, by taking every opportunity of hearing good public speaking.



(12.)



(13.)



(14.)

Unfortunately, the opportunities of this kind are few and far between, for good speakers are rare. About fifteen years ago I heard the lessons read in church with such marvellous effect by an accomplished speaker, that I have never forgotten the particular chapters read upon that evening.

Once again, lately, I had a similar experience.

But only upon these two occasions during my experience as a pretty frequent church-goer have I heard the lessons thus beautified. I do not believe in learning elocution from books, although there are many volumes written upon the subject. One which I recently looked over—I had not the patience to read it through—was the veriest balderdash. The writer worked upon the system of selecting some well-known poem, and then giving directions for its recitation, especially pointing out where the accents should be laid. Now, anyone who is not deaf and dumb, *knows* where the accent should fall, and there is no need to tell him. For in reading, these accents come in as naturally as they do in music; and in both, contrast can often be enforced by a syncopation. But the ingenious writer referred to ignored all this, and dissected his examples with the most ludicrous effect.



CHAPTER VI.

LANTERN TRANSPARENCIES IN STAINED ALBUMEN.



FRENCH manual was published some time ago which dealt with quite a new application of photography in the production of proofs which owe their density to the application of one of the aniline dyes This manual is by

M. Geymet, and he not only describes the application of the process to photographs on paper, but also to transparencies on glass. This last application of it we are at present alone concerned with. The method depends in the first place upon the same chemical phenomena as some other processes, among which we may mention the carbon method, and the Woodburytype; that is to say, it takes advantage of the action of those salts which are known as the bichromates of the alkalies, of which the bichromate of potash is a well-known example. Admixture of one of these salts with any colloid substance such as gum, gelatine, etc., will cause that substance to become quite insoluble after insolation or exposure to light. It is a developing process, but the development is in its

nature more mechanical than chemical. Albumen is the colloid substance employed, and it plays the principal part in the process.

The order of operations necessary in producing lantern pictures by this method is briefly as follows. Thin clear glass of any convenient size—for it can be cut down to the standard lantern size subsequently—is covered with a coating of chromated albumen, that is to say, albumen which has been impregnated with one of the salts already mentioned. It is then dried and exposed to diffused light beneath the negative in the ordinary printing frame; after which the plate is simply developed in fresh water, when those parts not affected by light dissolve away, leaving the other insoluble portions on the surface of the glass to form the picture. The proof so obtained is now treated with any suitable aniline dye, which has been dissolved in alcohol; it is then rinsed with water to remove the surplus colour, and the picture is finished.

I will now describe the process in greater detail, and I may say at once that it requires much care in order to ensure success. The preparation of the sensitive mixture is the first thing, and to compound it the following three solutions must be made up:

A.

Gum-arabic, pure (pulv.)	..	5 grammes.
Distilled water	..	100 c.c.

In another vessel mix:

B.

White of egg	..	25 grammes.
Distilled water	..	100 c.c.

C.

Ammonia bichromate	..	..	2.50 grammes.
Potash bichromate	..	..	2.50 „
Distilled water	..	..	50 c.c.

A and B are now mixed together in a basin and beaten up with a fork. Or a more effectual method is to place the mixture in a bottle together with a number of fragments of glass. After corking up the bottle, give it a vigorous shaking for two or three minutes until the albumen mixture is thoroughly frothed up. At the commencement of this shaking operation add a quarter of the sensitising liquid C, and gradually add the remainder, giving a vigorous shake between each addition until the whole has been so added. The operation must not be hurried, and should be carried out the night before the compound is required for use. After an hour or two, when it has subsided, repeat the shaking or beating into a froth as before, and then let the mixture rest until the following day. The next operation is to strain the liquid through paper filters three times, after which treatment the milky-looking fluid should have become as transparent as water. If the best results are wanted, the mixture should be used fresh, and certainly not after two or three days, for after that time it gets insensitive, and must have more of the bichromates added to it in order to make it serviceable. But even with this precaution it would not possess the qualities of a freshly prepared mixture. It will therefore be as well to prepare only as much as can be used up at once.

The next operation is to coat the plates with this chromated albumen, and I may observe here that the addition of the

gum to the albumen makes the coating porous, so that the aniline colour which is afterwards applied to it will penetrate it to some depth. It will be found that the mixture, in spite of its thickness, will flow well over the glass plates—not so readily, certainly, as collodion will, but if the glass be first of all thoroughly washed, and if, moreover, we take the precaution, as in coating gelatine plates, to rub over it as a final operation a little alcohol on a piece of wash-leather, we shall find that the sensitive mixture will traverse the surface without much difficulty. If with all these precautions, the glass should seem to be repellent of the liquid, a piece of card or a glass rod will help in the coating operation.

Before attempting to coat, the greatest precautions should be taken against the access of dust, for, as in coating gelatine plates, dust is the great thing to dread. It will therefore be as well some time before conducting this part of the work to sprinkle the dark-room floor and its table with water, and the inventor of this process recommends the further precaution of allowing the steam from a vessel of boiling water to moisten the air, and to coax down the floating dust. Just before coating, the glasses should be brushed over with a badger-hair brush to remove any little particles of dust which may have settled upon them.

The mixture is poured on the glass, whilst the plate is supported in a horizontal position, on a previously levelled surface, and the surplus from each, as in the case of similar coating operations, should be poured into another vessel, in which stands a glass funnel furnished with a filter paper. The time occupied in coating a number of glasses, if they

be placed side by side on a levelled slab, will only amount to a few minutes. They have next to be dried, but in this drying, heat from any source whatever must be avoided, for we must remember that in albumen we have to deal with a very different substance to gelatine. Gelatine will dry if a moderate amount of heat be applied to it; but if it be attempted to dry by heat a plate treated with albumen, the albumen will coagulate, and the plate will be spoilt. We must therefore depend solely upon ventilation for drying; but as slow drying would be likely, for other reasons, to lead to failure, it is as well to fan the plates as they lie on a level slab, using a piece of cardboard for the purpose. If in spite of all care in coating, dust and air bubbles make themselves disagreeably apparent while the plate is yet wet, the best way of getting rid of such intruders is to blow them by means of a tube towards the edge of the glass, and then remove them with the finger or with a piece of card. The operation of coating, and the general preparation of the sensitive liquid, may be carried out in a bright yellow light, for the plates, like all photographic preparations in which the bichromates are employed, are very insensitive whilst wet, but when dry are in a far more sensitive condition, although still many hundred times less sensitive than the bromide plates with which the photographer has generally to deal. The plates thus prepared and dried may be put away in a grooved box, and will keep for a day, provided that no white light reaches them, and that the atmosphere in which they are kept is free from gaseous or other fumes. In this respect the plates are subject to the same influences as sensitised carbon tissue.

We now come to the exposure of these plates. It will be as well, before placing one of them beneath a negative in the printing frame, to test it with the finger, in order to see that it is perfectly dry, and if there be any suspicion of dampness, it is a good precaution to rub the plate with a little French chalk, applied with the tip of the finger. The glass may then be placed beneath a negative in a printing frame, and exposed to diffused light. If the negative be very dense or discoloured, direct sunlight may be allowed to shine upon the printing frame; and the time in that case will be four or five seconds in summer, and about double that time in winter. But with a good negative which is normal in colour and clear in the shadows, we shall do very much better by exposing to diffused light, that is to say, such light as we get reflected from the sky on the shady side of a house. In this case the exposure will be prolonged on a bright day to four or five minutes, whilst on a dull day the time required may be from fifteen to twenty-five minutes. But, of course, as in most photographic operations, this question of exposure, upon which so much of the success depends, is very much a matter of experience. It is certain, however, that if the plates be not freshly prepared—for instance, about two or three days old—the exposure must be very much prolonged, and after all, as we have already intimated, old albumen, or old plates, are most uncertain in the results which they will afford.

After exposure we may immediately proceed to development, which, as I have already stated, is more mechanical in its nature than chemical. The plate is removed from the printing frame, and under yellow light is placed in a deep

and large bowl or basin full of clean water. In about two or three minutes the soluble part, that is the part of the albumen film which has been protected by the dark parts of the negative, will dissolve. The operation is automatic, and follows a regular course, and in order to insure this regularity, it will be as well, during the next two or three minutes, to change the water at least twice, taking good care that no force of water is applied to the surface of the plate, for the image, which is gradually forming, is, as yet, of a very tender character. We cannot, as in ordinary development, watch the progress of the work, although we may be able to see that a change is gradually occurring on the surface, by inclining the bowl at an angle so as to view the glass by reflected light. But presently, on the application of the aniline dye, it will speedily be seen whether the foregoing operations have been carried out as they should have been.

If the glass is allowed to dry thoroughly after exposure, it will be found that the colour will hardly penetrate it at all, and the picture will have but little density; therefore the colouring operation should take place whilst the film is yet moist, and it is actually ready for treatment directly it leaves the bowl of water, but it should be allowed to drain for a few seconds, so that the surplus water may be carried off. The dye may then be applied to it, by pouring it over the film whilst the glass is held by one corner, after which the plate must be kept horizontal for about half a minute or so, in order to give time for the dye to penetrate into the albumen coating. After this, the surplus dye may be drained away, and the plate may be washed. This

washing can take place in another bowl of water, and in order to make it thorough, the hand may be employed to gently lave the surface of the plate. The colour acts upon the albumen mechanically, and hardens it, so that after this application the film will bear far rougher treatment than before. If the image seems to be at all veiled, this veiling, or surface fog, will very quickly give way to continued washing ; and the best plan to pursue is to place the glass, film side up, in a dish of water, so that at least half an inch of the liquid covers it, and then to turn a stream of water from a rose upon it. This will generally clear the image, but the action must not be carried too far, or loss of density will ensue.

After this last washing, the film must be dried spontaneously, and then it only remains to varnish it to complete the lantern picture. But a little care is necessary in this concluding operation. The varnish must not be the ordinary spirit varnish, which is commonly used in photography for the protection of gelatine films ; for the spirit in such a varnish would react upon the colour, and would cause it to spread over the clear parts of the picture, and utterly ruin the effect. The varnish should be one in which some other solvent than spirit has been employed. Such varnishes are so easily procurable that I need not further dwell upon this part of the subject.

The dyes employed may be almost any of the aniline family, but whichever be chosen it must be dissolved in alcohol, so as to form a saturated solution, that is to say, the alcohol must be caused to take up as much as it will. The best way to gain this end is to put the

powdered dye in a small phial, pour the alcohol upon it, and shake it up at frequent intervals; if the whole of the dye is taken up by the solvent, add more of the powder, until a residue which refuses to dissolve is found to remain at the bottom of the bottle. Before use, the solution of colour so prepared should be filtered through porous paper.

There are a great many subjects for which this process will be found of use. A blue dye may be chosen for pictures, which may be thus made to represent moonlight effects; in like manner, an orange dye can be used for photographs having good cloud effects, so as to give the idea of sunset. But the process will be particularly valuable in the preparation of astronomical slides, either from natural photographs or from prepared designs. In a negative, for instance, which has been taken by means of a telescope, and which consists of a portion of one of the constellations, the various stars will be described as little black points of light. Such a negative, if printed by means of one of these albumen plates, and afterwards dyed with a suitable blue, will give the effect of the natural firmament, while the stars themselves will be represented by absolutely clear glass. We might say the same of the photograph of a nebula, of a comet, or even of a flash of lightning. There are many other ways in which the process will be found very valuable in the production of lantern transparencies.





CHAPTER VII.

LANTERN SLIDES BY REDUCTION FROM LARGER NEGATIVES—
CONDENSERS—WATER LENSES, ETC.



MOST convenient apparatus for reducing pictures to lantern size from larger negatives was recently brought out by Messrs. Marion, and is shown at fig. 19, and as it has the merit of cheapness as well as simplicity, it is likely to come into extensive use. It consists of a box containing a central partition, to which is fixed a lens. At one end of the box—that marked N in my diagram—is a recess, in which is held the negative to be copied, whilst at the other end (P) is a rebate in which is held the lantern plate. The lens is so fixed that the negative and lantern plate will be in the right position with regard to each other and with regard to the focus of the lens, so that all the operator has to do is to put them in their places and adjust the cap (C) over the plate, while he carries the apparatus bodily towards a window, or some source of artificial light, as the case may be.

It must be acknowledged that without some such apparatus as this the business of reducing a negative is a troublesome one, for it is an out-of-the-way operation. But with this contrivance it involves no more trouble than

putting a negative and plate in a frame for printing by contact. The outer grooves shown at the negative end of the box are for the insertion of a piece of ground glass, in order to diffuse the light when a lamp is used as the luminant.

This instrument is at present made in three sizes—half-plate, whole-plate, and 12 by 10—the latter having carriers, so that it can be used for any smaller sized negative. All these are so arranged that they reduce the image to lantern size. But I think that the makers would do well to issue a similar apparatus of quarter-plate size. I have

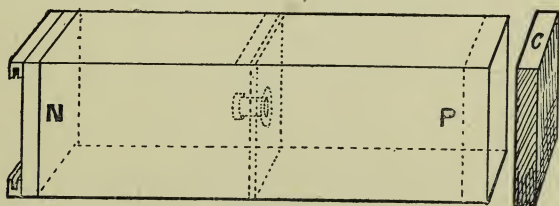


FIG. 19.

had such a piece of apparatus, differing only in details, for my own use for a long time, and I have found it in many ways a valuable help in lantern-slide making. The lens is fixed, and the length of the box on either side is just double its focal length. This arrangement permits one to reproduce a picture the exact size of the negative employed. It was doubtless felt by the makers of the apparatus figured that there was no necessity for issuing one of quarter-plate size, because it is almost universally the custom to print slides from such small negatives by contact in a printing frame. This is true, but where I find the arrangement so useful is when I want to produce a slide by

the wet process—when actual contact is out of the question—and one must separate the wet plate from the negative by strips of thin card. This is always a risky operation, for the nitrate of silver may, in spite of all care, get to the surface of the negative and ruin it. Again, I find the instrument valuable in working the collodio-bromide process, where, although the film is dry, it is so extremely tender that abrasion often occurs in bringing it into contact with the negative.

It may be affirmed without question, that a slide is somewhat sharper if taken by a lens, rather than by contact, but the difference can only be detected by very careful examination. When I have a lantern slide to make of a diagram which consists of very fine lines, I prefer to take it by means of a lens, so that I may obtain the greatest possible sharpness; but for ordinary work, contact gives sufficient exactitude. I have before me, as I write, for instance, a lantern slide which has been printed by the contact method. The subject is a couple of ships alongside a quay, and the picture takes in the whole of the rigging of the two vessels. Among the network of ropes are some which appear on the glass to be as fine as a spider's web, and it would be thought that no method of printing could confer upon them greater accuracy and sharpness. But to secure this result certain precautions are necessary. The glass must be flat, and the light during exposure must not be allowed to act laterally. A contact-printed slide should therefore be held in its printing frame some feet away from the source of light; and even during exposure to diffused daylight the careful operator will, by preference, expose the

frame at some distance from, and presented towards a window, employing what, for all practical purposes, are parallel rays.

Another valuable contrivance for reducing pictures to lantern size has been produced by Messrs. Shew, and this has an advantage in forming an attachment to any description of camera. For this purpose the ordinary front of

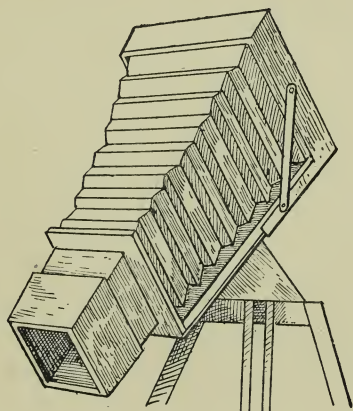


FIG. 20.

the camera is removed from its grooves, and the attachment put in its place, as seen in fig. 20. This apparatus consists in reality of an extra camera, formed of two boxes, one sliding within the other, as a help to focussing. The outer end of this box has a groove to hold the sensitive plate in an ordinary dark-slide, while the negative to be copied is held at the back end of the large camera. A tilting board, which can be screwed to any tripod stand, allows the complete apparatus to be turned skyward during exposure.

There are two grooves at the larger end of the apparatus, one to hold the large negative, and the outer one for a sheet of ground glass to diffuse the light. It is worthy of note that this apparatus, used the reverse way, can be employed for enlarging from a small negative.

Messrs. Perken, Son, and Rayment have called my attention to the model of a camera which they are about to issue, which will be of very great service to the slide producer, for whose delectation it is, indeed, intended. It is shown at fig 21. It consists of a base-board, upon which travels the central frame (*a*) by rack and pinion motion. Upon each side of this frame—which carries within it a partition to which is screwed the lens—is a bellows body terminating at one end in a focussing screen, and at the other end in grooves for the reception of a dark slide. It is evident that with such a camera as this, reduction, or reproduction the same size, can readily be carried out. The negative to be copied is placed in a dark slide, the central partition of which has been removed, so that light from any suitable source may penetrate it. At the other end of the instrument is placed another dark-slide, holding the lantern plate. Focussing, and reduction to any exact size, can be carried out very perfectly and conveniently with such an apparatus as this, which promises to come into extensive use.

But, as a matter of fact, it is not absolutely necessary to keep in actual darkness the space between the camera and the negative to be copied, as the presence of this bellows arrangement on both sides of the lens would seem to indicate. Both negative and plate must be parallel with one another, and this is best brought about by placing an ordinary

camera on a base-board or table furnished with rails between which it can slide, and taking care that the negative is strictly perpendicular to, as well as rectangular with, those rails. Under such conditions it is quite sufficient to fit the negative into a space cut in the bottom of a box, the box itself lying on its side with its open end towards the lens. We may also modify the arrangement by using two cameras, one to hold the negative, but having its lens and front removed, and the other pointing its lens within that front opening.

It may now be useful to review the different methods by

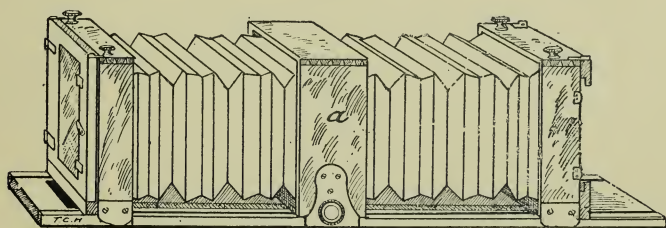


FIG. 21.

which a negative may be illuminated for the purpose of lantern-slide making. For obvious reasons, we must exclude daylight from consideration. Our aim must be to illuminate the negative evenly, so that no part of it receives more light than another part. This apparently simple proceeding is not so easy as it at first seems to be, and in the case of large negatives presents many difficulties. There is no great difficulty in illuminating a quarter-plate negative, which can be done with a good paraffin lamp or by a batwing burner ; but in either case we shall not secure even lighting

unless we interpose a sheet of ground glass between the negative and the light-source. And here let it be observed that this ground glass should be fine in texture, and should not be so close to the negative that its grain is focussed with it, or we shall have the grain appearing in our lantern slides and ruining the shadows of all our pictures. Care must also be taken that the ground glass is at a sufficient distance from the lamp to secure even diffusion of light. What I mean is this: Suppose we have a paraffin lamp to work by, and we place in front of it and at three inches from the flame, a sheet of ground glass. On observing the effect from a distance of six feet, we notice that the flame makes a kind of central flare spot, and that the edges of the glass are much darker. By moving the ground glass screen further away from the lamp, this effect becomes reduced, until a position is reached where the whole of the glass appears to be equally illuminated. It is at this point that the ground glass diffusing screen should be placed when we require its help in reducing from a negative, and the remark applies to the various forms of apparatus already noticed in which ground glass is employed to attain the same end.

In the case of a large negative this diffusion point will be so far from the light that the exposure will be extremely long, and it is questionable whether it is worth while to attempt reduction under such conditions. By daylight it would be easy enough, for we can then use the sky itself as our field of illumination, and even if we are hemmed in with back walls and chimney pots so that no sky is available, we can reflect its light through the negative by using a

piece of white cardboard sloped at an angle of 45 degrees. But if we try the same plan with lamp light, the exposure will be terribly long. I have succeeded in working at night from such negatives, but the preparations have been somewhat too elaborate for casual workers, including as they did the mounting of two powerful lime jets with the necessary connections to turn them off and on at the same time. Two lights are necessary, because if the cardboard screen is illuminated from one side only, that side of the picture is double the density of the side furthest away from the light, and there is a strongly marked gradation from one to the other. The same effect is noticeable in copying pictures at night. Capital copies can be made by gas or paraffin, but two lamps or burners should always be used. A friend of mine does a great deal of copying work at night, and I one day asked him what the average exposure was with the two gas jets he was using. He replied that he did not know, but that each exposure just gave him time to sit down at the piano in the next room and play one of Mendelssohn's *Lieder ohne Worte*. This is certainly a novel method of measuring photographic time, and one which would horrify the compilers of exposure tables, but all the same this conjunction of two arts is pleasant to see.

A very great saving of time is secured by the use of a condensing lens between the light-source and the negative. These lenses can now be purchased at a much cheaper rate than heretofore, because they are in so much request for enlarging operations, and demand has of course cheapened the supply. With such a lens, and a good gas flame, or better still, the three or four wick lamp from an oil lantern,

the business of producing lantern slides from larger negatives can be conducted with convenience and dispatch. The compound condenser which I use is of the common form, consisting of two plano-convex lenses mounted together in one cell, with their curved surfaces almost touching one another. The condenser is conveniently set in a square wooden frame, so that it can be readily moved into any position required. The size of the condensing lens should agree in diameter with the diagonal of the negative which it has to illuminate. A quarter plate, for instance, measures between its extreme corners, about five and a half inches. The proper sized condenser to cover it is obviously one of six inches in diameter.

Many years ago large vessels of lenticular form made of white glass were sold, chiefly for the use of chemists, who filled them full of different fluids so as to turn them into coloured lenses. Lenses of this kind were generally fitted into outside lamps, and it was no uncommon thing to see a bare space above the coloured fluid owing to evaporation of the contents of the vessel. The contrivance was simply a lenticular bottle with a little neck at the top, through which it could be filled or emptied. I cannot ascertain whether such bottles are now made, and few persons seem to remember them. About ten years ago too there were brought forward water lenses of the same character which were advocated for the use of shops. These were employed with a bat's-wing burner behind them, and answered the same purpose of attraction as a light fitted with a concave reflector. Now it has occurred to me that if such contrivances were still obtainable they would be largely used by amateur

photographers, both for enlarging purposes and also for illuminating negatives for reduction. But to come into common use they must present the advantage of being far cheaper than the usual condensers of glass.

Experiments with hollow lenses filled with coloured glycerine, which are intended for signalling purposes, have recently been going forward under Government supervision. These lenses are the invention of an officer, and, thinking that they might prove useful in various photographic operations, I called on the makers and inspected them, only to find that they were quite useless for such purposes—with the exception that one filled with glycerine which has been stained red would form a brilliant light for the dark-room. The reason of their unsuitability for other purposes is that they are not of the usual lens form, but are shaped like a ship's side light, so that the light from them may cover an angle of 90 degs. This shape permits the two glasses of which they are composed to be cemented into a metal frame, and the whole contrivance is as easily put together as a small table aquarium.

Although I am not in a position to say whether or not water lenses have been employed for photographic purposes, it is certain that they have been used in other branches of science. In the year 1872 Dr. R. M. Fergusson brought before one of the Scottish scientific societies a simple apparatus which he had designed for exhibiting wave motion, the principal part of which comprised a hollow lens filled with liquid. This apparatus was described and figured in the *Quarterly Journal of Science* for April of the same year, and I have thought it worth while to reproduce the drawing,

so that those interested in the matter may be able to see what has already been done (fig. 22). It will be noticed that Dr. Fergusson's apparatus is supported by an ordinary chemical retort-stand, a contrivance which ought to be possessed by every photographer, so useful is it in all sorts of

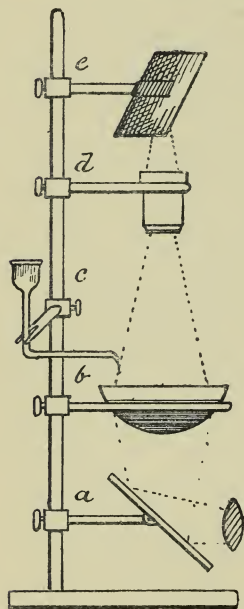


FIG. 22.

operations that come within his ken. In the present case the stand is furnished with five attachments, which are clamped to the main stem in the usual way, and which it will be convenient to letter from the bottom upwards, A, B, C, D, and E. A is a mirror which turns the luminous ray from the light source—in this case a lime jet—from the horizontal to the vertical position, so that it may traverse and be condensed by the liquid lens B. This lens, we learn, was made by cutting the top from a well-formed glass shade, and measured eight inches in diameter. Its actual diameter must, however, be measured at the surface of the contained liquid, which was found to be six inches. I fancy that glasses like enlarged watch glasses, and which are made to cover clock faces, would be the better article to get for this purpose. In the case before us the containing vessel is actually deeper than would be required for most purposes, for here the liquid had to be disturbed in order to induce wave motion. This was brought about by means of the bent

thistle-headed tube C, which, by means of a tap and finely pointed exit tube, could be made to emit drops slowly or quickly. The liquid employed was spirit, on account of its greater limpidity, but water would be used for ordinary optical work. Next above this liquid lens is an ordinary lantern objective or photographic lens, and above this again we have another sloping mirror to once more turn the vertical ray to the horizontal direction, so that the image formed by the objective lens may be projected upon a screen. A still more simple arrangement, under the title of "water lantern," is described in Mayer's little book on the phenomena of sound. Of this I give a sectional drawing in fig. 23, from which it will be seen that the apparatus takes the form of a box on end, but open at one side for the introduction of the light rays, from whatever source they may be obtained. These rays are received by the sloping mirror M^1 , and are reflected by it towards the condensing water lens P. Upon the surface of

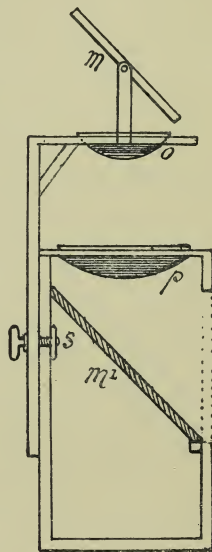


FIG. 23.

the water may be laid a plate of thin glass, which will serve both as a defence against dust, and also as a convenient transparent table upon which slides and other objects for projection can be laid. Above this there is a smaller water lens to act as an objective, which is held in a moveable shelf, the height of which can be carefully adjusted by the screw nut S. To crown all, there is a second

mirror M, swung like a toilet glass between two uprights, whose duty it is to bring the light rays once more to the horizontal position for projection upon a screen.

It is evident that in both these devices much light must be lost by reflection. This might be obviated in fig. 23 by dispensing with the lower mirror, and putting in its place a lime-jet in such a position that the luminous side of the lime would be presented towards the lens. There would be no great difficulty in this, for a lime-jet will burn well in any position in which it may be held. The heat from it rising upwards, would tend to cover the lens with moisture, but this could be obviated in the description of lens under consideration by filling it with warm water instead of with cold.

The glass cover to the lens at once suggests the construction of one which shall remain permanently closed, and which shall be available in the horizontal or vertical position. The construction of a compound condenser, consisting of two plano-convex lenses of large size, should not present any insuperable difficulties. In constructing one element of such a condenser the first thing would be to obtain a concave glass, and a flat glass of exactly the same size. These should be ground with emery and water for half an inch on both sides round their edges. The next thing would be to procure a metal annular frame of this section , and to carefully putty them in with a mixture of white and red lead in oil, leaving a small hole in one of the glasses, at the extreme edge, through which the lens could be filled with water after the cement had hardened. It must be remembered that unless such a lens were quite full of

liquid it could not be used in the horizontal position, for any air bubble that remained would naturally find its way to the highest point, and would make its presence evident upon the screen.

Those who are familiar with the lime-light will doubtless use it for this work in preference to any other illuminant, and the gain in time will of course be considerable. With a compound condenser such as I use, a sheet of ground glass as a further aid in diffusing the light over the negative, and a good lime jet, the work becomes quite luxurious. The light given is constant, and as in these days of amateur excellence one man's negatives are as alike in density as peas in a pod, little variation in exposure is necessary. The condenser should have in front of it a grooved frame into which one negative after another can be dropped, while it yields its image to the lantern plate. By screening one part of the room, and taking the precaution to use covered dishes, one plate may be developed while another is being exposed, the two operations going on simultaneously.

A word as to the best form of screen to employ for lantern projection will not be out of place.

In cases where the lantern is being constantly used, whether for trying slides in the amateur's workroom or for demonstration in lecture theatres and schools, it is of importance that a suitable screen or sheet should be available at a moment's notice. This should be made of opaque material, for it must be remembered that all light which filters through such a screen is lost, and the pictures suffer proportionately. A whitewashed wall makes the finest lantern screen—and this is provided in some few lecture

theatres—the unsightly patch of whiteness being hidden, when not in use, by curtains. But a portable screen which is quite as effective has recently been put on the market by Messrs. Mason and Payne, the map publishers, of Cornhill. This is made of strong cloth, faced on each side with paper, so that it may be quite opaque to the rays from the lantern. The cloth is stretched, shrunk, and mounted with its paper facing, by experienced hands, so that the surface is as flat as a whitewashed wall, and far whiter, for the pigment which is subsequently applied to its front surface so as to give it a finish, is the finest oxide of zinc, a material which does not like flake-white, darken with time. These screens are fitted with roller and lath, so that when not in use they are rolled up out of sight like a window blind. They are made in all sizes, the largest ever made being perhaps that which was used for my photographic lectures in the theatre at the Crystal Palace. This measured thirty feet square, and contained, therefore, 100 square yards of material. About forty pounds of zinc oxide was used to give it its snowy coat of white, and the pictures projected upon it were consequently of extreme brightness.





CHAPTER VIII.

LANTERN SLIDES ON GELATINE PLATES.



LONG after the gelatine process had almost displaced wet plates for negative work, there were many accomplished photographers who expressed the opinion with great vehemence that although the new system had placed a fresh power in their hands, it was quite unfit for producing good lantern slides. And this notion is one which seems difficult to eradicate, for it is stated in quite recent books on photography, that wet plates are by far the best for transparency work. It is certainly the easiest, and on the whole the best for the commercial production of slides, but I cannot agree that gelatine must take a back place. On the contrary, some of the first examples of lantern slides which I have ever seen have been made on gelatine plates. And the dealers have at last been converted, for within the past year "lantern plates" have been introduced by most manufacturers, and are largely used by amateurs.

These plates may be roughly divided into two classes, namely, chloride plates and bromide plates, and we will now see what advantage each kind offers to the worker. I my-

self have a weakness for the first named, and believe that if their exposure and development be carefully attended to, they will give the finest possible results, while at the same time they afford a variety of tones unattainable by any other process. The chloride plate has, too, one distinct and enormous advantage in the amount of light which it will stand during development, without any fear of fogging. When we remember that the beauty of a transparency so much depends upon stopping the developing action as soon as the required amount of density is apparent, we must admit that a brilliant light under which the least change can be readily noted without any straining of the eyes is one of the first elements of success. A brilliant paraffin lamp with a single sheet of thin yellow paper pinned round its globe, is perfectly safe for a chloride plate, and will at the same time illuminate the whole of the so-called dark room. Another advantage which may be credited to the chloride plate is its quickness under development, it being quite possible to take several dozen pictures in the course of a couple of hours, provided, of course, that the negatives be ready at hand, and that everything is in due order. On the other hand, the plates are so insensitive to light that they cannot be used for reduction in the camera, and *must* be printed by contact. The exposure to gas light is far too protracted for quick work, and if the negatives are of the old-fashioned yellow kind, it is almost impossible to work by gas even with very long exposures. Daylight is the most certain light to which to expose such plates, the average exposure being about three seconds. I am aware that many recommend the use of magnesium wire, but this light is uncertain,

difficult to control, and the fumes given off by the burning metal are certainly objectionable, if not injurious. So I may sum up the matter by saying that I prefer chloride plates for lantern slides, provided the operator has the chance of making his exposures in daylight. There is no doubt that this proviso will place the process out of court for the many whose only leisure time is in the evening; and this circumstance, together with the unsuitability of the chloride plate to reduction work in the camera, has stimulated manufacturers in offering a bromide plate which offers no such objections.

I have tried, I think, all the bromide lantern plates which are offered for sale, and am pleased to say that all are good. Some I naturally prefer to others; but it would be invidious to name any one brand in particular, for it is quite possible that I have not adopted in all cases the most suitable developer for the particular plate under examination. Whilst they are far less rapid than the plates used for negative work, they require care against undue access of light during treatment, and the dark-room lamp must be screened with a red, not a yellow medium. This darkening of the working light renders the attainment of the proper density, as already indicated, far more uncertain than in the case of chloride plates, and the beginner, at any rate, will find that his collection of ghosts, as well as overdone prints, will accumulate pretty quickly. But the exposure to gas-light is certainly a convenience which many will appreciate, especially as a great deal of latitude is obtainable by the simple expedient of increasing or diminishing the distance between the printing frame and the lamp. More-

over, this exposure, lasting, as it does, for at least twenty seconds, gives the operator every chance of shielding certain portions of the negative, so as to get effects of distance and atmosphere, which will often confer a charm even upon the slide from a poor flat negative.

Should a gelatine positive on glass not be dense enough to give full effect in the lantern, it is far better to throw it away than attempt to intensify it, for it is easy enough to correct the fault in exposing another plate. But, on the other hand, if a mistake has been made in the other direction, and the picture, while full of detail, is too dense for the light to penetrate through the film, the fault can be easily rectified, and if reasonable care be taken, a fine picture will often result. To reduce a dense picture (and this plan is, of course, applicable to an over-dense negative as well), mix a solution of fresh hypo of half the usual strength, and put it in a small dish. A couple of ounces of solution will be quite sufficient. Then in another dish make a weak solution of red prussiate of potash (ferridcyanide), say 10 grs. to 2 ozs. of water. Allow the slide, which requires reduction, to remain in the first solution for a minute or two, and then, without washing it, transfer it to the other dish. Watch it well, for the action is so rapid that over-reduction may ensue. Remove quickly, and place the slide under the tap. This remedy is also useful for that common fault, a dirty sky, owing to penetration of the light through a thin negative. In this case paint over the sky with the dilute hypo, and follow with the prussiate solution, using a camel-hair brush in both cases. In little more than a minute the sky will be effectually cleared.



CHAPTER IX.

CLOUDS IN LANTERN PICTURES.

NO one will deny that a lantern picture is often improved by the addition of clouds, and if these happily appear in the one negative, so much the better. Sometimes clouds are so buried in the over-dense sky of the negative that it is a difficult matter to get at them. Sometimes local reduction may be advisable, and if the worker is afraid of doctoring his negative with chemicals, after he has looked upon it as finished and done with, he may with advantage adopt that mechanical mode of reduction which is possible by rubbing with old linen moistened with alcohol. (This method will, by the way, often unearth the details of a church window, which before had been lost in halation.) If, however, there are no clouds in the negative, and a large expanse of white is the printed result, we must adopt other means to remedy the defect, for defect it is. In the case of a snow scene, or, indeed, any picture where there are brilliant high lights, the sky can be toned after printing by exposing it to light, shielding the rest of the picture. It can even be done after partial development—the redevelopment finishing the land-

scape and toning the sky at the same time. But when actual clouds are requisite, a separate cloud negative must be used. The work is by no means as easy as it is in the case of a silver print on paper, for the reason that so much judgment is required during the exposure, first of the landscape, and then of the sky negative, the actual results not being apparent until development. Some advocate the printing of the sky on a separate plate, and then making that plate the cover glass of the finished slide. But the difficulties are increased by such procedure, for the image of the clouds is reversed. I believe that the best plan to adopt is as follows. First of all select the sky negative for use, taking care that the clouds are lighted from the proper direction. (To make all safe, it is as well to make a trial silver print from the combined negatives, in order to see if one is really suited to the other.) Next fix a 3-inch mask on the glass side of each negative, so that the lantern plate can readily be removed from one to the other, and will be in register for both. Measure the height of the horizontal line on the landscape negative, and if it be, say, an inch and a half from the bottom of the paper mask referred to, make a pencil mark at that height on the mask which is affixed to the *cloud* negative. Now give the necessary exposure to the landscape—preferably by gaslight, as then there is plenty of latitude—and then (by ruby light) remove the plate from its frame and place it in another frame, on the cloud negative. Fasten it up securely, turn the frame over, and note the position of the pencil mark on the mask. Now turn up the gas once more, and during exposure shield that portion of the plate below the pencil mark with a piece

of card. Keep the card in motion well above the mark so as to get a graduated tint, and after due exposure turn down the gas and prepare for development. Be sure to have at hand a ten per cent. solution of bromide, with a camel-hair brush in it ready for use. It may not be wanted, but if it should be, it will be wanted badly. For instance, the sky may soon show that it has received more than sufficient exposure, while the landscape has not had enough and hangs back. In such a case, rinse the sky portion of the plate, and paint it over with the bromide solution ; then redevelop. But a little practice with this method of double-printing will render such dodges unnecessary, for the operator will soon acquire the habit of exposing his plates to suit the needs of both negatives. But when all is said and done, the best effect is to be obtained when the one negative is adorned with natural clouds. Very often in this climate clouds are more common than is desirable, especially as they generally hold a remarkable quantity of rain ; but on the sunny days vouchsafed to us the clouds are welcome, from an artistic point of view, at any rate. In lately looking over a set of instantaneous seascapes taken last autumn on the south coast, I was surprised to find that a cloudless sky was the exception rather than the rule. One more word. Do not lose the opportunity of securing cloud negatives, for they can be obtained on days when other photographic work is next to impossible. At the same time, make a note by compass of the direction in which the camera is pointed, and the hour at which the negative is taken. Similar notes regarding landscape negatives will enable the operator to wed any two without a sacrifice of truth. Thus, sup-

posing, for the sake of illustration, we have a picture of Shakespeare's Cliff, taken at 5 p.m., in August, from the Admiralty Pier, of which it is due west. A westerly sky negative taken in the same month, at the same time, can be associated with it without hesitation. The question of altitude of clouds need not trouble us if the camera be always kept level, and the horizontal line be made to register in both landscape and cloud negatives, as I have already pointed out.

Most instantaneous shutters are so constructed that they will give a much shorter exposure to the sky than to the landscape beneath, and if clouds be present they will be reproduced in the negative in a printable form. A shutter for the express purpose of producing pictures adorned with natural clouds was invented some time back by Mr. Leisk, and is sold, I believe, by Messrs. Marion. But I fancy that it was adapted more for seascape, where there is an unbroken horizontal line, than for more general work. In my own practice, when I am anxious to secure cloud effects I use a shutter which was designed and brought out about twenty-five years back by Mr. Dallmeyer, but which, like many other things, has been of late years revived and re-introduced, in a slightly altered and perhaps improved form. In its modern dress it is known as Place's shutter, and its chief merits lie in its simplicity, and in the control which the hand can exercise over it during exposure. It consists of a frame having two grooves, in each of which slides an ebonite plate. These plates are connected together by cords which run over a small roller at the top of the contrivance. When one ebonite plate is down in front of the lens, the

other is raised in its groove out of the way. By a string attached to this upper plate it is pulled down, and as it descends the other plate rises and the exposure is made. The duration of exposure, and the amount of extra time devoted to the exposure of the foreground, is therefore directly under the control of the hand which pulls the string. I have found it convenient to keep this shutter on my lens during the whole of a day's tramp with the camera, for, as will be evident, it is serviceable for any kind of subject which is likely to be met with, from that which requires a quick exposure, to the many seconds wanted when the camera is beneath the shade of thick foliage.

There is one thing to be guarded against in the use of separate cloud negatives, and that is the tendency to use them for every picture without consideration. In our exhibitions a large proportion of the works hung are often spoilt by being wedded with incongruous clouds, and many amateurs seem to think that if there is only a little patch of open sky it must have a bit of cloud pitchforked into it somehow. This is a mistake. In landscapes containing plenty of subject, and more especially in those in which there is a tracery of foliage against a large portion of the sky, the picture is the better for not being tampered with. A sunlit landscape photograph is very often spoilt by association with a dark cloudy sky through which in nature no sunlight could possibly penerate. I may mention in concluding this portion of my work, that an excellent article on printing-in clouds in lantern slides from the pen of Mr. Lyonel Clark appeared in the October (1889) number of the *Photographic Quarterly*.



CHAPTER X.

ON FRAME MAKING.



THE amateur photographer who is skilled in the use of carpenter's tools has a great advantage over his fellows, for he can not only fit up his dark-room with all kinds of conveniences, but he can make part of his apparatus with his own hands, and thus be independent of outside help. Those with long purses are apt to decry the efforts of the amateur carpenter, and perhaps naturally prefer to call in professional aid. But in doing so they quite lose sight of the pleasure which a man derives from constructing things for himself, and the advantage of producing results at the expenditure of a few shillings, whilst others will spend as many pounds, and fail to do as well. It may be said that picture frames are so cheap that it is not worth while to attempt to make them at home. But this argument might be applied to a hundred other things besides frames—and even to photographs themselves—for no one can say that nowadays they are not cheap. The true amateur will never listen to such pleadings, for his pleasure is found in his hobby and the thousand and one little employments which it brings to him.

I feel sure, therefore, that many of my readers who have leisure will be disposed to take up the art of frame-making, and will thus be able to beautify the walls of their rooms with the work of their cameras. The power of being able to make a frame will also often induce them to give a welcome present to a friend, and one which will be the more valued because it is of an unusual character.

As a beginning, the amateur frame-maker should confine himself to the purchase of mouldings, which are sold of various patterns in lengths of about 10 ft. A plain, flat oak moulding, with a gold slip inserted beneath the glass, is a safe pattern for a photograph, for it will always look well on any wall. But the most captious will be able to find a pattern and style to suit him, for the different mouldings now obtainable are of the most varied description.

Photographs of an ecclesiastical character will often look well in an Oxford frame, because of its cruciform corners. But it must be remembered that there is a stringent and very necessary law against the admission of pictures so framed to all exhibitions—not because there is any moral wrong in framing a picture in this way, but because their presence entails loss of wall space. An Oxford frame may be likened to an octopus, by reason of the eight projections with which it is furnished, and for which room must be found, unless they are at once ruthlessly amputated. Intending exhibitors must, therefore, eschew the Oxford style of frame, or keep them for home use. They are easy enough to make and no one who has purchased one as a pattern, and is a little skilled in the use of tools, can fail even in the first attempt at constructing one. The only point where he is likely to

be baffled is in cutting the rebate, in which will subsequently rest the picture, glass, and back. For this work, as well as for more general purposes, I have employed a very useful little tool, which I purchased long ago in Liverpool, and which may, for ought I know to the contrary, be obtainable in London, but I have never seen it here, except in my own workshop. It is shown at fig. 24, and is known as a rabbeting tool. It is here shown full size, and its parts will be readily understood by help of the reference letters. The

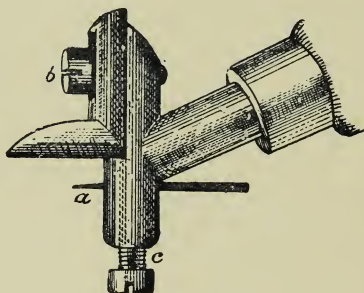


FIG. 24.

vertical part is round, and made of brass, with an oblique stem springing from it on the right-hand side, which forms the shank to which the handle (not shown in the cut) is attached. C is a set-screw, the duty of which is to hold the cutter *a* tightly in position after it has been adjusted to give a cut of a certain depth. Another set-screw, *b*, controls the position of a kind of right-angled shoe, which is hollowed out so as to clamp upon the vertical part. This shoe has a flat side facing the cutter, and it will be readily understood that its distance from the cutter can be adjusted to any

desired distance. Thus it will be seen that the depth of cut can be regulated, and also the width of the rebate which is cut. In the position in which the tool is shown in the drawing, the piece of wood upon which it is desired to operate would be held rigidly on the edge of the work bench or table, and after the cut had been made to its full depth, by repeated strokes the tool would be turned over so that the cutter acted vertically upon the top face of the same piece of wood. By this means the two cuts would meet, and a square rod would be cut out from the material operated upon, the space occupied by it forming the required rebate. By adjusting the set-screws between the two cuts the width and depth of the rebate can, of course, be varied to any required measurement. This useful little tool is invaluable to the amateur photographer, because it can be applied to so many other purposes. Suppose, for instance, that a carrier is required for the accommodation of a plate in a dark-slide which is far too big for it. This rabbeting tool will soon cut the necessary groove for the reception of the glass after the carrier has been cut out of soft pine. It is also of service in cutting the tongue upon each side of a temporary camera front, and for many other purposes too numerous to specify. Its cost is only about one shilling, and it is so solidly made that it will last a lifetime.

The necessary tools for general frame-making are few, but they should be of the very best quality. Their cost is very little, if the amateur worker be a good enough carpenter to make his own mitre-block and shooting-board. But let him not attempt to make these unless he is a first-rate workman, for if either be the least out of truth, every frame made wil

suffer for the fault. Both of these necessary appliances can be bought ready made, and I advise that they should be obtained thus, to save both disappointment with results and much loss of temper.

The simple mitre-block—whose duty it is to cut off lengths of moulding at an angle of 45 degs., so as to form a mitre joint at each corner of the frame—is shown at fig. 25. It needs but a few words of description, so simple is it in design. It consists of a baseboard, upon which is firmly glued and

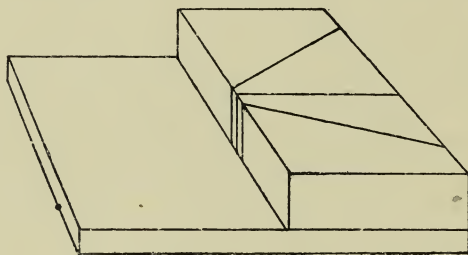


FIG. 25.

screwed from below a somewhat thicker piece of wood, in which are three saw-cuts. One of these is straight across the centre, and the other two are each cut at an angle with it of 45 degs., but in reverse directions. The contrivance, it will be seen, forms a step, upon the lower level of which is placed the wood, or moulding, to be cut. By aid of the middle saw-cut—which now serves as a guide for the saw—the piece of wood thus inserted may be cut straight across, or, by utilising either of the other cuts, at an angle, which will at once render it fit to serve as part of a picture frame.

The other contrivance, pictured at fig. 26, is the shooting-board, which needs almost less description than the mitre-

block. Here, again, we have a step arrangement, and a means of holding the lengths of moulding which have already been cut on the mitre-block, in such a position that a plane run on its side along that lower step will effectually shave off enough of the cut end to make a clean join with another end which has been similarly treated. I may mention here that if the saw used in the first operation be of the right description, a fine tenon-saw, the necessity for this after-business of shooting—that is, planing—will be

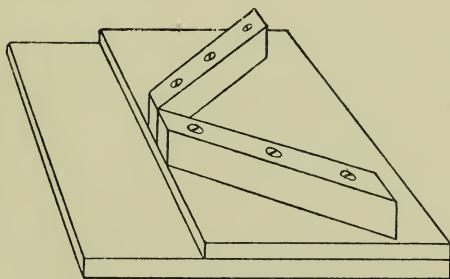


FIG. 26.

obviated, provided that the mitre-block is absolutely true. It must be true not only with regard to correct angles, but also in respect to the saw-cuts, which must be perpendicular to the baseboard, otherwise the frame will not lie flat—that is to say, its parts will not occupy one plane.

There is another form of mitre-block, shown in fig. 27, which presents some advantages, and certainly it is a very easy one to construct. In this case the saw always occupies the same position in the transverse saw-cut, the pieces of wood, or moulding, being moved to the right or left of it as may be required. The only objection to the use of this instrument is that few persons are educated up to using

either hands indifferently. Usually the right hand is used for guiding the saw, and in this case the left hand must be stretched over it to hold the wood whilst it is being cut. Those who use both hands indifferently will not suffer this inconvenience.

It need hardly be pointed out that the plane used for this wood must be square in section, or it will not give a true vertical cut when laid on its side. The actual form of the plane beyond this does not much matter, but it must be

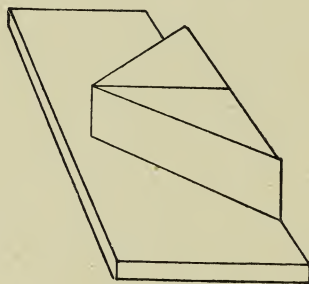


FIG. 27.

sharpened and set to a very fine adjustment. There is a description of plane made with a single, instead of a double, iron, which does well for the work, but an ordinary "jack" or a "trying" plane will answer the purpose. Still, it is far better to devote a plane to this one purpose, and to use it for nothing else. A form of plane which cuts with great ease is one in which the iron is set obliquely—called, I believe, a bevel plane. All these different forms are made with the handle set in the side, instead of in the top, immediately behind the iron. This side arrangement gives better control over the tool, as it slides to and fro on the lower step of the

shooting-board. But the instrument which is better than any for frame-making is a good metal plane. It can be set to cut a far finer shaving than a wooden tool, and it has the advantage of weight—that is to say, when once in motion it does half the work by its own impetus. It is not, moreover, subject to the scratches and other evidences of wear and tear which are common to wooden planes.

There is nothing new about the methods of cutting a mitre which I have detailed. Indeed, I should suppose that the mitre block and shooting board can themselves boast a very high antiquity. And a proof of their efficiency is found in their present popularity with the trade. Peep into the workshop of any professional frame maker, and you will see these venerable but effective appliances still at work, in preference to a number of more modern contrivances for performing the same offices. It is not by any means my purpose to decry the various appliances for cutting mitred joints which are now sold, for some of these are extremely serviceable. It would, indeed, be wise for the frame maker who can afford it to buy one of these machines as a labour-saver; but, from my experience of them, I am bound to admit that the cut which they make, although apparently clean and regular, is all the better for a finishing touch with the plane on the shooting board. Whether this want of exactitude is due to spring in the metal composing the cutting blade of the machine, or to the elasticity of the wood when cut under slow pressure, it is difficult to determine. But I should think that both causes contribute to the result. It may be the outcome of clumsiness on my part, but I certainly find that a frame

made in the old-fashioned way has better corner joints than those cut by machine.

If the amateur should have many frames to make, it is perhaps the best plan to cut and shoot the four pieces comprising each, and after placing them in position on a flat surface to see whether the corners meet one another well, to tie up those relating to each particular frame, leaving the joining up to take place when all are ready for that stage of the work. By following this procedure the hand becomes accustomed to each operation involved, and a gradual improvement in the way in which it is executed will soon become manifest.

To make a good join, the best glue must be employed, and it must be used freshly mixed, for, as all users of gelatinous bodies should know, every time the glue is melted it loses a certain amount of its tenacity. It must also be hot as well as fresh, and must be applied to the work neatly and quickly. To glue up a mitred corner, place the longer piece of moulding in the bench-vice in a vertical position, and hold its fellow to it in the position it is to occupy permanently, but slightly overlapping the part which is held in the bench vice. The necessity of this precaution will be seen when the brads to hold the two pieces together are driven home, when it will become evident that there is a natural tendency upon the upper piece to slide downwards on the inclined plane formed by the cut edge of the lower piece. Holding the upper portion in the manner described, a hole should be bored downwards with a small bradawl, and in this hole a brad is inserted with the fingers. The pieces are now separated, the glue

applied sparingly to each surface, the pieces joined once more, and the nail driven home with the hammer.

Various forms of mitre-cramps are sold which are used to hold the freshly-joined corner firmly until dry, but here again we can adopt an older-fashioned method with advantage. Cut out of close-grained wood, such as beech, a series of L-shaped pieces, of a thickness corresponding with that of the frame to be made. When all four corners of the frame have been joined up as described, place it flat on a table, and furnish each corner with one of these L pieces. Now stretch a strong cord right round the frame so that each L-piece is held firmly in position, after which, by twisting a stick round the cord, great tension can be put upon it, and the whole frame is bound tightly together until the cord is released after the glue has had time to dry.

Even though a frame has been well made, our work is not finished, for some little art and care are necessary in placing the picture within it. Unless this be done well and in such a manner that the air is wholly excluded, both back and front, our labour will be lost. It is a common thing to see a framed picture with its mount begrimed with smoke or dust, and generally discoloured. The reason of this is the omission of one very necessary precaution which should always be observed in framing water-colour drawings, photographs, or any description of picture which must be protected by glass. This consists in sealing the glass into the frame so that no contamination can reach the face of the picture. The way to do this effectively is as follows:—First see that both frame and glass are perfectly clean, and that the latter fits the rebate without leaving a vacant

space between the glass and the inner side of the moulding. Glaziers are the most careless of workmen, and it seems a matter of indifference to them whether a glass fits well or badly in a frame which is entrusted to their tender mercies, a difficulty which the amateur will avoid if he only will take the trouble to learn to use a diamond himself. Having a well-fitting glass placed within the frame as it lies face downwards on a blanket-covered table, proceed to attach some previously cut slips of good stout paper by means of glue, to the edge of the glass. This should be done in such a way that the glass is actually glued into the frame all round, and cannot fall out when the frame is inverted. Next place the mounted picture upon the glass, and finally fill in the back with the usual board. A good frame maker will use for this purpose a properly planed and joined board, so that it has no seams through which the ever-present dust can get inside. But the modern cheap and nasty frame maker thinks it quite sufficient to insert a few rickety and very knotty boards, which would be quite useless for any other purpose under the sun. The quality of the board does not really matter very much, if it be, after nailing into the frame, completely covered with good brown paper by means of glue. Dust and smoke must be kept out by some such means, and their exclusion is particularly necessary in the case of photographs.

All narrow frames, whether they be of oak, ebonized wood, or any other material, are much improved by the insertion of a gold slip next to the picture. This can, like the mouldings, be bought by the length, and can be obtained of the same dealers. It is a false economy to use anything

but a slip which has been covered with real gold leaf. The imitation ones look well for a time, but any scratch unseen at first soon develops into a black line, and this is the case even if it be placed under the glass. This course I recommend in all cases, even with the real gold slip, for it is by this means protected from all external influences, and will always remain clean and bright.

It will be seen later on that gilded frames receive a final coating of clear size made from parchment cuttings. This seems to somewhat dull their appearance when first applied, but the coating is a useful protector from dirt and dust. A frame of this description which has begun to look as if it required regilding can often be renovated by the home worker. All that is necessary is to carefully sponge the frame with hot water, and to once more give it a coating of protective size.





CHAPTER XI.

ON FASHION IN FRAMES.



HERE has been somewhat of a revolution in the matter of picture frames during the past few years, and, as a rule the elaborate frames of past days are giving place to those of a far more simple and less ornate character.

In our permanent picture galleries we can still see the scalloped gilt monstrosities which our forefathers considered necessary to set off their pictures. But in a modern gallery we see few of these old-time frames, for they have been superseded by those of newer fashion. It must be admitted that some of these are so simple in character that they border on the eccentric. For instance, that wayward genius, Van Beers, who has during the past few years had an annual exhibition of his own works, seems to despise the ordinary gilt frame entirely, and prefers to use a frame made of wood stretched over with coarse canvas and painted with green distemper. Many of his pictures I have seen thus framed, some

measuring something less than a photographic quarter-plate being furnished with a frame quite nine inches

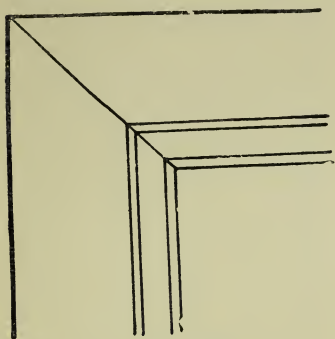


FIG. 28.

in width. This arrangement certainly has the advantage of preventing the works being crowded, or injured in effect by juxtaposition, but it is extremely eccentric. Van Beers, however, is not the only painter who rejoices in queer-looking frames. Mr.

Whistler treats his pictures

in much the same way, and evidently with the intention that the spectator's eye should not be enticed away from the principal object. This

is all very well, but the idea may be carried too far, and is carried too far, especially by those of our younger artists who are trying to found a new school of painting. The eccentricity of their pictures is often only exceeded by the peculiarity of the frames in which they are set. In

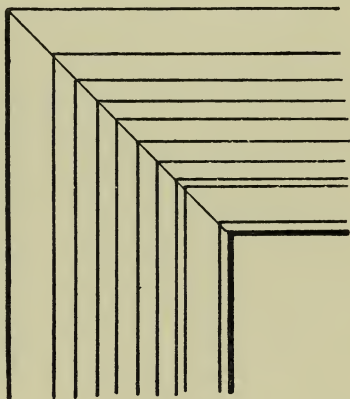


FIG. 29.

portraits of eminent men it would always be well if the frame could be made consonant in some way with in-

cidents of their lives, or with their studies or works. Thus a portrait of Sir Isaac Newton might be framed

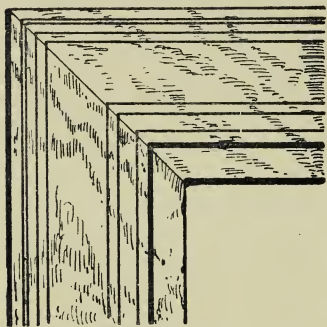


FIG. 30.

in carved wood, depicting some of the apparatus used in his researches, just as, in the case of the portrait of another famous Izaak—the father of anglers—which is hung at Brasenose College, the frame is adorned with rod and tackle and other mysteries of the fisherman's stock-in-trade. In a

recent exhibition in London, I noted with pleasure that an Egyptian subject was framed very happily in gilded wood, upon which were carved representations of hieroglyphics, whilst the two uprights on either side were columns modelled from those of Egyptian rock-cut temples. This plan of framing a picture with regard to its subject is much to be commended.

But we must remember that the large majority of persons whose portraits are painted or photographed lead humdrum, colourless lives, and it would tax the ingenuity to its

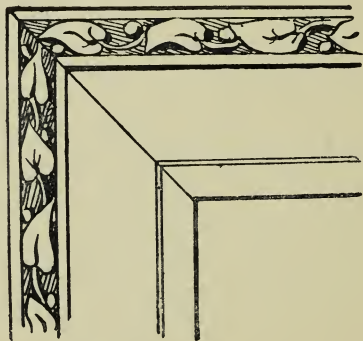


FIG. 31.

utmost to frame them in a distinctive manner. For ladies' portraits I have lately noticed the introduction of a type of frame which is very effective, and which I fancy is of French origin. It consists of a simple flat, covered with canvas of very open texture, which is glued to the wood and then gilded or silvered. Upon this flat, which has the general ap-

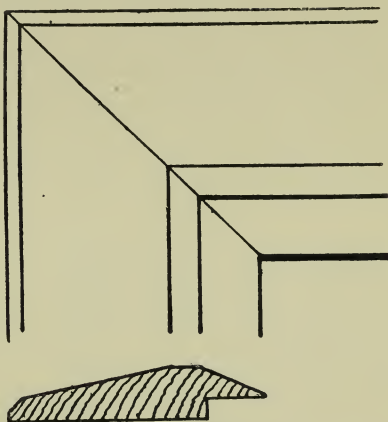


FIG. 32.

pearance of frosted metal, is attached at one corner a sprig of some flower, also in gold or red bronze. This ornament has the charm of carelessness, and is most effective. The same frames, too, instead of being covered with canvas, may be glued and sprinkled with rice, or any kind of grain, being afterwards silvered or gilt. Gilded oak

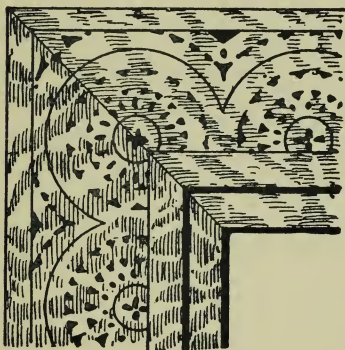


FIG. 33.

frames of various designs have also come lately into fashion, and if the wood be of handsome figure—by

which I mean beautiful grain—and this grain be allowed to show well through the gold, the effect is as fine as can be desired. This is, moreover, a kind of frame that is well calculated to show off a photograph.

Many amateurs who have tried any form of gilding have been tempted to give it up in despair. This arises principally from the circumstance that the gold-leaf used is so extremely thin and light that it is the sport of

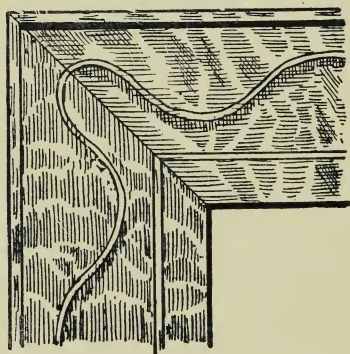


FIG. 34.

every breath of air, and it invariably shows a disposition to cling to everything except the precise spot for which it is intended. Like most other delicate operations, this one of gilding requires an apprenticeship before it can be practised with any perfection, and it is very doubtful whether an ama-

teur worker, however skilled, will ever be able to master, without this apprenticeship, the art of matt gilding and burnishing. Under these circumstances, it would seem to be futile to recommend an amateur to attempt to gild his frames, and it would be so were ornate mouldings with burnished lines and projections under consideration. But the matter of gilding an oak flat or rounded moulding is comparatively simple, and well within his powers. The operation has, moreover, been simplified by the introduction of the transfer process, by which the gold leaf is kept well

in hand, and unable to stray away during the progress of the work. This transfer gold is sold in leaves, which are attached to waxed paper, an attachment which is finally overcome by the greater tenacity of the medium employed to stick the metal to its final support.

I will now briefly describe each pattern of frame which is here illustrated.

Fig. 28 consists of two flats of dead gold—one forming a kind of inner slip to the other. Fig. 29 is of ribbed dark or stained wood, with a gold slip next the picture. Fig. 30 is a moulded oak frame, gilded so that the grain or figure of the wood shows up clearly through the gold, and catches the light in a very pleasing manner. I may mention that such moulded wood is sold at many sawmills, for decorative purposes, and by a little building up at the back may be rendered serviceable for picture frames. Fig. 31 is more elaborate, because it has a carved border, but the major part of the frame is flat oak gilded. No. 32 is a bevelled frame, the bevel running in two different directions, as may be seen by reference to the sectional diagram. Such a frame can be made of various materials, so as to suit the picture or the wall upon which it has to be hung. This latter point, although a minor one, is of some importance. Plain oak looks well almost on any wall, for it is neither very light nor very dark in tone. Ebony frames look well on dark walls, but afford a violent and unpleasant contrast to a light one.

Fig. 33 has a more elaborate appearance than the frames already noticed, because of the pattern carved upon it. The

frame can be made of oak, and the pattern marked upon it by means of a stencil ; the marked portions being afterwards cut out with a carving tool—no very difficult matter. The frame from which I copied this pattern was gilded oak, and was in keeping with the subject of the picture which it held—the courtyard of a stately old building. No. 34 is also a gilded oak frame, with a kind of raised wavy bead upon it, which forms a loop at each corner.





CHAPTER XII.

ON FRAME-MAKING, AND GILDING.



W^{OOD}AK, like other wood, is porous and greedy of moisture of any kind. The first operation, therefore, is to give it a coating which shall act as a support for the gilding medium to be afterwards applied to it. Strong parchment size—which, like everything else required in this work, can be bought at the gilder's material shops—is the substance to use after it has been melted, with the addition of a little hot water. This size must be strained, and painted well into the wood with a hog-hair brush—the work being done not too quickly, so as to avoid any frothing of the liquid. After being so treated, the frame is set aside to dry thoroughly, after which it will be improved by being rubbed down with the finest glass paper, and sized once more. Again the frame is dried, and now it is ready for the coat of medium which is to hold the gold-leaf to its surface.

This medium is known to the trade as oil gold size, and it is applied to the wood with a flat camel-hair

brush. After this coating of gold-size, the frame must be set aside in a place quite free from dust for a period ranging from twelve to twenty hours, the time being governed by the quality and age of the gold size, and also to some extent by the weather. For during this time the varnish-like fluid gradually evaporates, and it must be allowed to do so until it has

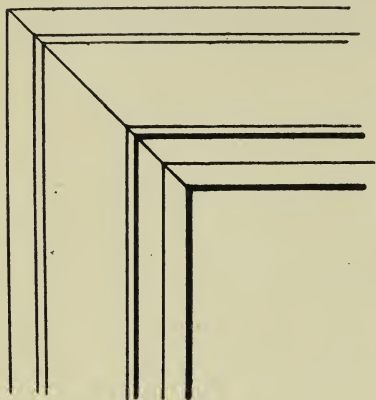


FIG. 35.

reached just that point of "tackiness" when the gold will adhere to it best. When this point is reached, the gold-leaf—previously cut *en bloc* with a pair of scissors to the best size to suit the moulding to be covered—is pressed on bit by bit, each piece overlaying the edge of the other until the entire surface is covered. Now let the frame rest for a

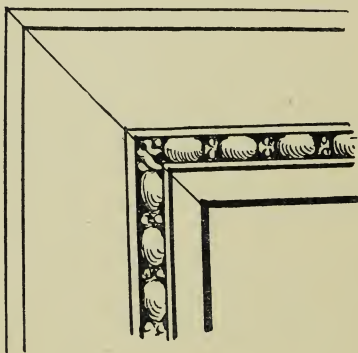


FIG. 36.

few more hours, and lightly dust off the superfluous gold with a clean dry cloth. The operation is completed by giving the gilded surface a coating of *clear* parchment

size, which protects the delicate surface from all attacks of contaminated air, etc.

At a recent exhibition in London, I was interested in

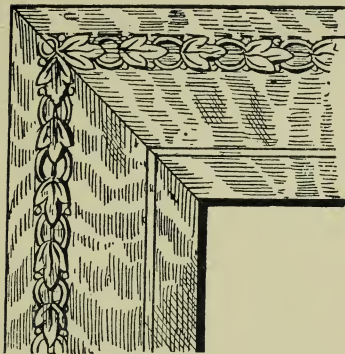


FIG. 37.

noticing the new styles of frames which many of the artists had adopted, and I amused myself by making thumb-nail sketches in my catalogue, both of the pictures themselves, and also of their frames, in cases where the more ordinary patterns were departed from. These sketches I have reproduced here, and

it will be seen that many of the designs are so simple that they can very readily be adopted by the amateur frame-maker. In many cases I have shown how the beauty of the frame can be enhanced by preserving the grain of the wood, and this grain is far more noticeable if the wood be gilded than if it be left bare. There is certainly, in the case of oak, no course between the two extremes—at least, in my

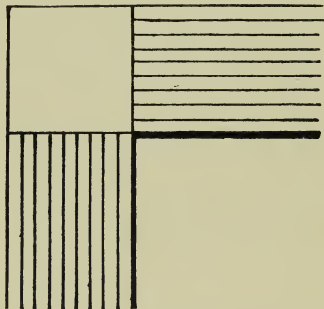


FIG. 38.

humble opinion. Varnish, or polish, in any form is simply execrable, and if the wood be left entirely unprotected, it

soon gets dark and grimy. In the case of a simple beading, this does not much matter, for a little rubbing with glass paper will soon give it a new surface ; but if the frame be elaborate in character this mode of treatment is not applicable.

Fig. 35 was remarkable for being made of rough dark-stained wood without gilding. It enclosed a large picture of a cottage interior, and

the subject was here again in accordance with the simplicity of the frame. Fig. 36 is

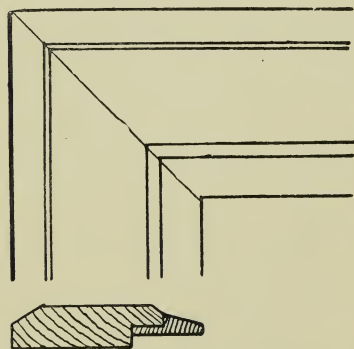


FIG. 40.

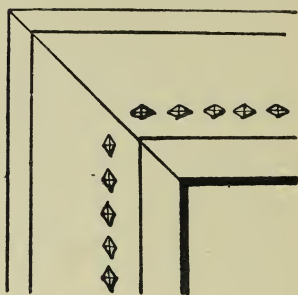


FIG. 39.

an unusual kind of combination ; the broad part of the frame being of dark wood bevelled back towards the wall, and the ornamental beading being made of metal, and having the appearance of oxydised silver. Fig. 37 exhibits another specimen of a pattern in gilded oak with a carved ornament near its outer edge. An effective

pattern for a wholly gilt frame is seen at fig. 38 ; and No. 39 is a gilt oak frame with raised diamonds upon it. This frame is more eccentric than effective, and as it had no possible reference to the subject of the picture, seemed to

be meaningless in design. Fig. 40 is a frame made of deal, and stretched with coarse canvas, which is afterwards coated with glue and gilded as already described. Figs. 41 and 42 are both plain oak frames with hollowed out panels. I copied these from pictures in the Grosvenor Gallery, and they were certainly effective. They can be made by building up pieces of oak, by any one having a slight knowledge of the use of tools.

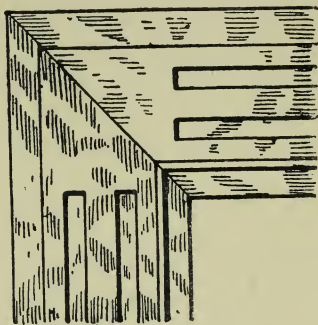


FIG. 41.

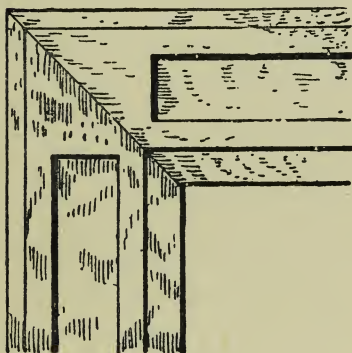


FIG. 42.

In frame-making we must guard against over-elaboration, and must constantly remember that, after all, the work must be subservient to the picture which it is destined to contain. This over-elaboration was the fashion in days gone by, so much so that it was not uncommon to hear an ignorant critic make remarks about the beauty of the frame, and paying

very scant attention to the picture. As we have already seen, there is a tendency now-a-days to go to the opposite extreme, and to frame a picture with such ostentatious simplicity that the verge of eccentricity is continually reached.

Many amateur carpenters are very skilful in fretwork, and useful treadle machines are now sold at a low price, which execute the work with ease and rapidity. Fretwork can be introduced as an adjunct to ordinary frames, and is effective if well done. But I think that it should only be used for portraits, and in imitation of those handsome Italian carved openwork frames which have long been in use for oil paintings. The best way to employ fretwork is as an appendage to an ordinary mitred narrow frame, which should have on its outer edge a rebate cut so that the fretwork ornament can be sunk therein, and so brought flush with the original moulding. The design should be bold in outline, and unlike in character to the fine work which used to be commonly employed for the front of a piano. It should be of such a nature too that the mitred corners will come well together, and not give the idea of a break in the pattern where the join occurs. Perhaps on the whole it is better to use fretwork for little fancy portrait-frames, which are supported easel-fashion on the drawing-room table, and stand among other knickknacks of a similar character. Under the same category come frames which are covered with coloured plush. These are easy enough to make, for they can be cut out of soft pine, and any little irregularity which may be at first apparent is covered up and hidden by the plush. The best cement to use in order to make the material adhere to the wood is a mixture of flour-paste and glue, the former correcting the brittleness of the latter. If glue be used alone the contraction of the plush has a tendency to strip it from its support.



CHAPTER XIII.

HINTS ON MAKING ENLARGEMENTS.



HAVE always been a great advocate for the use of small cameras, and have the courage of my opinions in so far that I seldom in my own practice use one larger than quarter-plate. I have pointed out on a previous page the

many advantages which the possessor of a small camera has over the photographer who works big plates, and have indicated that if the producer of small pictures wants an occasional large one, it is not difficult to attain his object by magnification of the original negative. It is only now and then that a negative will be considered worthy of this honour, and care should be taken that there is no mistake here, for a poor picture will look all the poorer when its defects are magnified. On the other hand, a negative which is full of detail, but which from some cause or other is too thin to yield a satisfactory proof by contact, will generally afford a fine enlargement. Especially is such a negative fitted for enlargement upon bromide paper.

Before attempting to enter upon the work of enlarging photographs, the operator should determine whether he wants a single positive from his negative, or whether he requires a large number, because upon the settlement of this question depends the shape which his work will assume. If one or two copies only are required, the bromide paper process is the one to adopt; but if, say, a dozen or more enlarged positives are wanted, it is far better to make in the first instance an enlarged negative, and then to print from that as many positives on paper as may be required. An undoubted advantage in this latter method of procedure is found in the circumstance that with such a negative we are not confined to one method of printing, but can adopt any we like, from fugitive albumen to permanent platinotype.

In carrying out any operation, it is obviously advisable to benefit by the experience of others by endeavouring to imitate the methods adopted by successful workers. But if we apply this method to the subject of enlarging, we are at once met with a difficulty, for no two firms who devote themselves to this class of work conduct their operations in the same way. One or two use daylight; another employs the lime-light, while at least one other uses the electric arc-light exclusively. For obvious reasons, daylight need not be considered here, and it is as well that such should be the case, for it is perhaps the most inconstant source of light that we can employ for the purpose. The lime-light is far more serviceable, and now that oxygen is obtainable commercially, it is within the reach of all. The electric light must for the present be discarded, but in the near future it will possibly be more easily acces-

sible than any other luminant, and most certainly it is the best that can be had for the purpose of enlarging photographs.

If we require to produce an enlarged negative, we must first of all procure a good transparency on glass, which may be of the same size as the original negative, or smaller or larger according to the conveniences which we may have at hand for producing it. In another work* I have described a method of enlarging, which I originated, in which very small positives are employed, and by which I obtain the best results. But the method is only applicable by those who care to undertake the trouble of plate-making, for large chloride plates are employed which are not obtainable commercially. The general worker will be obliged by circumstances to use bromide plates for his enlarged negatives, and he will do well to eschew those of a very rapid description.

The positive may be produced by any of the well-known processes, but it must not be the kind of positive which is best for the lantern. Exposure and development must be carried far enough to coax every bit of detail out of the original negative, and if a slight veiling of the lights is produced in the effort to do this, it does not in the least matter, as it would in the case of a lantern slide, for we do not want a *pretty* positive, but one which will yield us a good negative. We have an analogous instance in the case of a pretty black and white negative, in contradistinction to one which is rather yellow than black. The first will give

* "Book of the Lantern." (Hazell, Watson, and Viney, Ltd., 1, Creed Lane, Ludgate Hill, E.C.)

us a hard positive, while the less ornamental specimen will afford us one rich in exquisite gradation of tone and full of detail. It is better to produce such a positive by means of the camera, and one or two forms of instrument suitable for making lantern slides have already been given. Failing one of these, two ordinary cameras can be called into play, the lens of one pointing into the open front of the other.

There is a way of making an enlarged negative direct from a smaller negative without the intervention of a positive image, and although this method has been known for some years it seems to be very seldom practised. The reason of this neglect is doubtless partly owing to the uncertainty which is sure to attend first attempts, and partly to the circumstance that certain plates, particularly those having abnormally thick films, are unsuitable, and give poor results. The process, which I will presently describe, should not be attempted unless the lime-light be available, for one element of success is represented by a very long exposure—an exposure, in fact, which would mean ruin to an enlargement produced in the more ordinary manner.

The kind of plate used is gelatine bromide thinly coated, as already indicated, and its development must be brought about by the ferrous-oxalate method. The exposure must be considerably longer than the normal, so that when the developer is flowed over the plate the image shall appear quickly. Never mind fog or darkness, but develop until the picture is seen as a positive on the glass side of the plate. After development give the plate a very thorough washing under the tap, and then bleach it in the following solution :—

Potass. bichromate	..	..	..	2½ drs.
Water	..	..	..	3½ ozs.
Nitric acid (chemically pure)	..			1¼ „

Dilute before use with 15 parts of water.

Wash the plate once more after this bleaching operation, and resensitise it by flowing over it repeatedly, in a dish or whilst held in the hand, the following alkaline solution:—

Water..	..	..	7 ozs.
Ammonia bromide	..	..	1 drm.
Liq. ammonia fort.	..	..	1 drm. 8 minims.

The plate is now exposed to brilliant white light for from two to six seconds, and is redeveloped with the same ferrous-oxalate solution which was used in an earlier stage of the process. After another washing, the negative is fixed in the usual manner, and cleared if necessary with acid and alum. It may be noted here that a reversed negative will result if the two films during the first exposure in the enlarging apparatus are so placed that they face one another. Reversed negatives so produced would be invaluable if the subsequent positives are to be made by the carbon method. But for other methods of printing a reversed negative is not required, and therefore the original must during exposure be placed with its back towards the larger plate, or the latter must turn its back to the original.

This process in careful hands will yield an enlarged negative, which cannot easily be excelled, but it requires practice and very careful attention to details. The longer the time occupied in applying the ammonia solution to the large plate the more sensitive it will become. But it is

quite impossible to give more definite directions than I already have as to time of secondary exposure. This must be learnt by the experience which will be gained after the sacrifice of a few plates.

If the bromide paper process had not been introduced, it is doubtful whether the work of enlarging photographs would have come within the powers of the ordinary amateur, for all other processes by which magnified pictures can be obtained—if we except those within camera size—are either complex in their nature, or they entail apparatus of an expensive and cumbrous description. But the bromide process came to hand in the nick of time, and just when amateurs were being tempted to take up photography as a pastime by the ease and cleanliness of working which the gelatine plate inaugurated. The bromide paper process is easy to work, and in no part of it need the amateur fear any difficulty if he will only use ordinary precautions with regard to light access, exposure, and cleanliness in his manipulations. Under such conditions he will be able to produce from the smallest sized negatives pictures of which he need not be ashamed, and which will reveal beauties that were not suspected to lurk in the original.

The paper as now manufactured is so perfect that the amateur can start with the work with full confidence in the material with which he is about to deal. It was not so in the early days of bromide paper, for the makers had then much difficulty in finding a support for the emulsion which while possessing the necessary qualities as to toughness, etc., was free from deleterious matter which acted upon the delicate chemical coating. Hence it was then common for

pictures taken by this method to present all kinds of blemishes. Sometimes a picture would develop rightly, and would afterwards become afflicted with an obstinate attack of measles without any discoverable cause. I fancy that many of the faults exhibited by the original material were traceable to the circumstance that a far larger proportion of gelatine was employed as a vehicle for the sensitive salt than was actually required, and certainly far more than is employed in modern bromide paper. The paper as soon as it was wetted became slippery and unpleasant to the touch, and the gelatine surface was very easily abraded. At the present time the gelatine is reduced to a minimum, and I fancy that little more is used than is necessary to bind the particles of silver bromide together, and to cause the emulsion to flow over the rollers during the coating operation.

To obtain a really satisfactory enlargement upon bromide paper requires care and some exercise of judgment. A thin and clear negative, of the kind which would not yield a very good print on albumenised paper, is just the sort to pick out for enlargement. Dense or very yellow negatives, which afford no difficulty in the ordinary printing frame, are, on the other hand, likely to yield hard black and white pictures when enlarged. Development can be brought about with either ferrous oxalate, hydroquinone, or the new agent eikonogen. Some say that the last named will gradually displace the other two, but I myself have obtained such first-class results with the iron developer, that for the present I shall continue to use it in my own practice.

In using this ferrous-oxalate developer, a common mistake is to employ too much of the iron salt. 8 (I am assum-

ing here that the amateur compounds his own developer, by mixing saturated solutions of potash oxalate and iron protosulphate together.) In developing a plate so as to produce a negative, the proportions generally recommended are four parts of oxalate to one of iron, with a liberal amount of soluble bromide. This will not do for developing enlargements on paper, except under unusual conditions. The proportion of iron to oxalate which I have found to work best is one of iron to eight of oxalate, the iron being added to the oxalate, and not *vice versa*. Some workers do not care to employ any soluble bromide, but I think that it is a wise precaution to add a mere trace to the mixed developer, for its presence tends to keep the whites pure. This comparatively weak developer will allow the operator to give a liberal exposure, and this is necessary to secure a good black tone in the finished picture. When the image is well developed—and the action must not be allowed to go too far, for the colour deepens in the fixing bath—the developer is poured off and the print is flooded, without previous washing, with water acidulated with acetic acid—strength, acid, $\frac{1}{2}$ oz. to a pint and a-half of water. The paper picture must be next thoroughly washed, and finally fixed in the hypo bath—strength, $3\frac{1}{2}$ ounces to 1 pint of water. Allow the print to remain in the fixing bath for at least fifteen minutes, and take care, if two or three prints are being fixed at the same time in one dish, that they are constantly moved, so that one shall not prevent the salt attacking another upon which it rests. When fixation is complete, the paper appears translucent when held up to the light, but should any trace of cloudiness be apparent

it must go back to the bath until the paper becomes clear.

A word of caution is necessary here. If the paper print be left in the fixing bath for an extravagantly long period, the hypo will begin to attack the image itself, and the delicate details which form the most beautiful part of the picture will quickly disappear, never to return. This destructive action is quicker when a very small quantity of liquid is being used, and the surface of the paper in consequence gets exposed to the air while still in the bath. In former years it was frequently my lot to demonstrate in public the method of exposing and developing a bromide enlargement, and on one or two occasions while my attention happened to be absorbed upon other matters, a print which had been left too long in the hypo bath was spoilt in the manner indicated. It is possible that this accident may not occur with all makes of bromide paper, but I give a word of caution with reference to it, and am induced to do so because I have never yet seen in print the peculiarity referred to.

Many amateurs have told me that they have not tried to enlarge their pictures because they have no dishes suitable for the work, and the price of large ones is prohibitive to them. It is true that the larger sizes are expensive to buy, but it so happens that they can be made at home cheaply enough if the amateur can only do the work himself. The carpentry which the making of a dish involves is in truth so simple that it seems hardly necessary to employ a professional hand to do the work. Let me now give a few hints on the subject.

Dishes can be made in various ways, and some methods are far more simple than others. For instance, a good serviceable dish can be made of waterproof (Willesden) paper, the edges being turned up and the corners held together with strong letters clips. But this description of dish, if of large size, should stand upon a flat board, so that its centre shall not sag and get out of shape. A really flat surface for the bottom of the dish is, in fact, for paper enlargements almost a necessity, for the wet paper will cling thereon, and the dish can be moved at any angle to coax the developer over the paper without fear of the latter falling off. Of course, dishes can be made of wood, and then covered with a waterproof coating. A really good dish can be made in this way, of pine, with a lining of mackintosh cloth. Or, if the carpentry be of a trustworthy character, the wood can be painted with some composition which will render it waterproof. The best compound for this purpose is gas tar, laid on sparingly with a brush while boiling hot. This is by no means a pleasant stuff to work with, and in case of danger from fire the work should be done out of doors. A dish so prepared will not be ready for some days, for gas tar has a tendency to remain sticky.

In the photographic year-books a waterproofing compound for dishes has been constantly published among the formulæ, consisting of a mixture of resin and beeswax. This I have tried, and found it difficult to apply and very brittle in use. It forms, moreover, a soap with any salt of soda, so that a dish so prepared and used for a fixing bath leads to mess and trouble. A far better mixture to use is asphaltum dissolved in naphtha, a dish so treated remaining

for many years without alteration. For my part I prefer, above all other kinds of dishes, one with a flat glass bottom. They are not difficult to make, and I have several which have been in use for all kinds of purposes for many years. The sides of such a dish consist of $\frac{3}{4}$ inch pine, two inches in depth, with a $\frac{1}{4}$ inch groove cut along one face half an inch from the edge. This is for the reception of the bottom, which is made of thick glass, known in the trade as

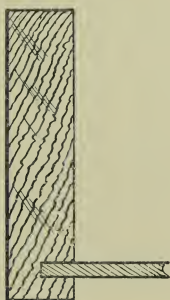


FIG. 43.

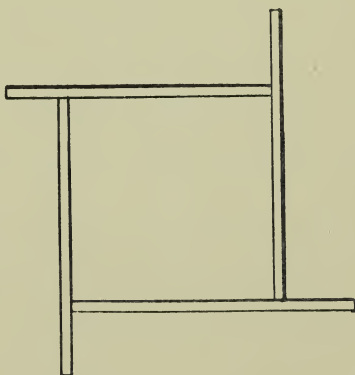


FIG. 44.

“32 ounce sheet.” It is cemented into the groove with a mixture of white and red lead in oil, and after the sides are tacked together, the woodwork is waterproofed with any one of the mixtures just given.

In order to make my remarks clear concerning the construction of these large glass-bottomed dishes, I here offer a diagram (fig. 43), which is a sectional view of one of the sides with the glass bottom inserted in its groove as already explained. In making this form of dish it is as well to

place the glass *in situ*, and to see that the corners will come together nicely before any cement is applied to the groove. If this should be the case, it will then be time to fill in the groove with its mixture of white and red lead, a large portion of which will be forced out as the glass is firmly pushed into its place. This superfluous stuff should be neatly removed and finished off with a knife when the wooden frame has been joined together. A first-rate carpenter will, of course, use a dovetail join here, but I prefer to simply pin the woodwork together with French nails, for should the glass bottom be at some future time broken, it can then be easily replaced by forcing asunder the corners of the dish. There is no kind of strain upon the woodwork, and the nails will be found all-sufficient.

A still simpler form of dish can be arranged as a makeshift out of four laths placed as shown in fig. 44. It is obvious that laths so placed can be made to form a rectangular frame of any size. The laths should be arranged as shown to suit the dimensions of the paper enlargement, and should rest on a moveable flat surface, such as a drawing board. After exposure, the paper should be thoroughly wetted, drained, and laid face upwards, so that the four edges just lap over the laths. The paper will now form its own dish, and the supporting board can be raised and inclined at any slope so as to coax the developer in any required direction. This plan is, of course, a makeshift, and has its disadvantages, but it is worthy of mention here as a means which may be adopted when no better one is available.

With regard to the method of supporting the paper in front of and square with the enlarging lens, little need be

said. Any form of upright easel which will bear a board upon which the paper can be pinned during exposure, will answer the purpose, and perfection of arrangement is reached when this easel can be made to travel on rails or laths attached to the floor, to and from the lens. In this way the scale of enlargement is increased or diminished at pleasure. A square box with an upright board nailed to one of its sides, and projecting upwards for four or five feet, is as good as anything that can be devised. The box can be made to run between two guiding laths on the floor, and the upright board will form a vertical easel. The paper can be readily attached to the board by means of ladies' bonnet pins, which are far more easy to handle in a darkened room than are the usual flat-headed drawing pins.

It may be thought that there is some difficulty in attaching a gelatine plate to this form of upright easel when it is desired to produce an enlarged negative instead of a positive on paper. There is no difficulty in the matter; indeed, strange as it may seem, the attachment of a glass plate to the surface is easier than pinning up a sheet of paper in the same place. By driving into the board three 2-in. French nails in the positions shown in fig. 45, taking care that they all incline inwards—that is, towards the centre of the board—a glass plate can be supported with ease and safety. The two lower nails serve as a shelf to rest the edge of the glass upon, and the single nail above, against which the right-hand upper edge is placed, keeps it from tumbling forwards. This clever little dodge I saw in practice at the Richmond works of Messrs. Morgan and Kidd, who fasten up large

opal plates in this manner during exposure. This simple expedient is of service in another way. Let us suppose, for instance, that an enlarged negative shows during development that it has not received sufficient exposure. The developer is washed off, and the negative can once more be placed under the influence of the lens, and, provided that no part of the enlarging apparatus has been shifted, its place on the three nails will bring it into the exact position

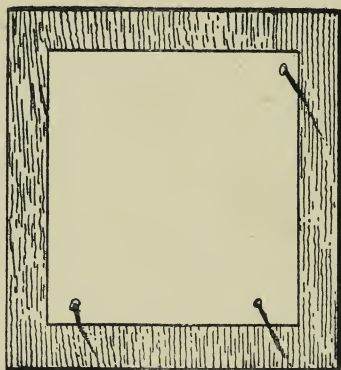


FIG. 45.

with regard to the lens which it occupied in the first instance. Partial development has, it is true, robbed the film of fifty per cent. of its sensitiveness, but it is still sensitive for all that, and the extra exposure will quickly tell under re-development.

Another point may usefully be considered here in the addition of clouds to a landscape the negative of which is dense and opaque. The method to which I am about to refer is applicable to a positive on paper, or on opal or

plain glass, and I see no reason why it should not be applied to the production of an enlarged negative from a small positive. But the principle is best explained if I suppose for the nonce that it is desired to finish a positive on opal plate with clouds from a separate negative. The clouds must, of course, be suitable to the landscape in question, and this matter has been fully dealt with in a previous page. The plate having been supported on the easel upon the three nails, receives the normal exposure, and is then developed. Development is only allowed to proceed to a certain point, when the plate is placed under the tap and is rinsed and drained. It is now replaced upon the supporting nails, and while the half-developed landscape is kept shielded by a card from the action of the lens, a cloud negative is allowed to trace its image on the blank upper portion of the plate. This second exposure having been carried on to a sufficient point, the plate is once more developed, and as the landscape portion acquires full density, the clouds gradually make their appearance. This method of working is most successful, and is in daily operation at those same works at Richmond where I learnt the little dodge with the three French nails.

Many forms of enlarging apparatus are now supplied by different makers, and although they differ in detail, they are necessarily the same in principle, and take the form of an optical lantern with a large condensing lens. Anyone who already possesses a lens suitable for enlarging can, by investing in a large condenser and a good three or four inch lamp burning mineral oil, rig up an enlarging apparatus for himself which will do good work. The best

form of lens to employ is one of the portrait variety, for it is quick in action, and when we are dealing with a comparatively subdued light, like that given by oil, the exposure becomes very protracted if we use other forms of lenses. The Euryscope is but little behind the portrait lens in the matter of speed, and I have found it invaluable for the present purpose.

In fig. 46 I have endeavoured to picture the way in which

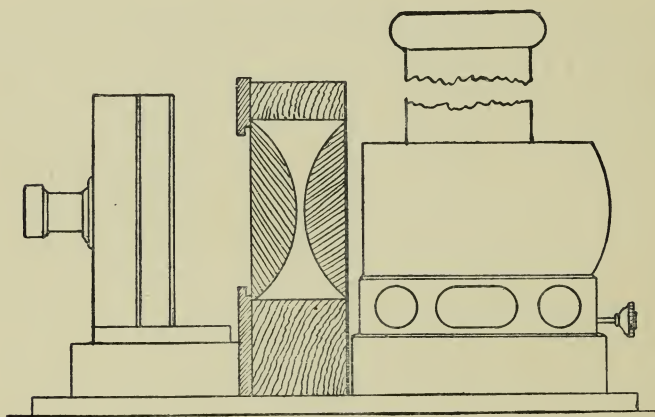


FIG. 46.

the various parts of the suggested rough-and-ready enlarging apparatus can be arranged. On the right hand side of the figure is the lamp, and against it is the double condenser, set for convenience in a wooden block. On the same block, on the side farthest from the lantern, are grooves to hold the negative which is to yield an enlarged positive on the distant easel, and on the left-hand side of the figure is the enlarging lens, fitted to a camera. In practice, of

course, all these different parts will require adjustment according to the focus of the lenses employed and the amount of magnification to which the image is subjected. Supposing that the operator elects to employ such a combination as suggested, his work should first of all be strictly experimental. Let him decide upon the size of the image which he requires, and place the various component parts of the apparatus upon a flat board. He can then light the lamp, fix a negative in the groove provided for it, and rig up a sheet of cardboard to receive its image. The first requisite is to obtain a clear disc of light, which is only possible when both lenses are accurately centred with the flame of the lamp. Both condenser and camera will probably require support upon pieces of wood before the right position is obtained. Next, the distance of lamp from condenser, and objective from condenser, must be seen to, and when both are in place, their position should be marked upon the base-board for future reference. The tables relating to enlargement will be useful, and can easily be found by reference to the annuals.

If, from the particular form of lamp employed, dispersed light should make itself troublesome, a sheet of cardboard with a hole in it, through which can project the camera lens, will form an efficient screen, or with a little ingenuity the entire arrangement can be boxed in. A square box with the lens fitted to it will answer the purpose of the camera, and the lens should have, if possible, a rack-and-pinion adjustment for the purpose of delicate focussing. Exposure should form the subject of many trial slips of paper, for it is quite impossible to give any useful infor-

mation upon the point, so much do the bromide papers of commerce differ in their rapidity.

Where unusually large pictures are required, the oil lantern is not a desirable illuminant, for the exposure required is enormous. In such a case the worker will do well to employ the limelight, which can easily be adjusted to the same form of apparatus.





CHAPTER XIV.

PHOTOGRAPHY BY MAGNESIUM LIGHT.



NOT by any means a new thing is portraiture by the aid of the highly actinic light afforded by burning magnesium. So long ago as the year 1865 it was proposed to use the metal magnesium in much the same way that it is used now, that is to say, for flash-light purposes. But there are two reasons why the suggestion was not taken up with alacrity, one being that the metal was at that time a very costly article, and the other reason being that the amateur photographer was almost unknown, and professionals were too busy in other ways to trouble themselves much about a mere matter of experimental interest. Nowadays flash-light photography has become so common that it would not be an exaggeration to affirm that tons of the silvery magnesium powder are dissipated in light and vapour during the winter season in this country alone. It is certain, too, that many use the metal as a help to daylight on those dull days with which all are familiar,

except those who have the good fortune to live out of range of city chimney pots.

Magnesium was first used as a help to photography in the form of wire or ribbon, and lamps were made in which it could be conveniently burnt. In the official report on the Paris Exhibition of 1867 I find the following reference to the use of such lamps: "The newly discovered metal, magnesium, by the brilliancy and whiteness of its combustion, resembling sunlight, has enabled photographers to secure pictures in vaults and other places inaccessible to ordinary light. It has also been made to supply the place of the sun itself in the solar microscope, or enlarging apparatus constructed on the same principle. In order to ensure its steady combustion, lamps have been contrived to secure the gradual supply of a ribbon or wire of the metal. Mr. Solomon, in England, exhibits a very convenient apparatus. The trial before the jurors was perfect. In Austria is a smaller but similar lamp for the same purpose."

The Commissioners who are responsible for this report are certainly wrong in speaking of the metal as being "newly discovered," for its discovery was made at the very beginning of the century by Sir Humphrey Davy. But as that great investigator only produced it in very small quantities, it could not form the subject of much experiment until by the labours of others it was brought within the commercial horizon. Solomon's magnesium lamp seems to have been the prototype of a number which have since been devised on precisely the same lines, possibly by inventors who never saw the original. It consisted of a metal box containing a train of clockwork, which fed the metallic ribbon between

rollers into a spout, which delivered it at the focus of a parabolic reflector.

Another form of lamp of about the same date as that of Solomon, is one devised by Larkin, to burn the *powdered* metal. The means by which this was accomplished were very ingenious, but quite different to the flash method with which we are all more familiar. The principal feature of the lamp was a hopper, or containing vessel, which was charged with the magnesium powder mixed with a certain quantity of silver sand, so as to help it in its flow—hour-glass fashion—through a small orifice. This orifice could be opened or closed by the action of a conical plug which was affixed to a lever action. When this lever was depressed, the orifice was uncovered and the powder fell in a steady stream on to the flame of a spirit lamp beneath, so that as long as the hopper remained open, and the store of magnesium and sand was not exhausted, a brilliant flood of light was given out by the lamp. That this light could be depended upon is proved to some extent by the circumstance that two lamps constructed on this principle were used at a meeting of the British Association to light up a refreshment tent and its attached garden.

Magnesium was used for another purpose about the year 1878, when Captain Colomb invented an ingenious form of flashing lamp for army and navy signalling. This consisted of a spirit lamp below which was a box containing a mixture of powdered resin, magnesium, and lycopodium. From this box proceeded two bent delivery tubes, the ends of which pointed directly towards the burning wick. Another pipe was also connected with the interior of the box, and this

was furnished with a long india-rubber tube crowned with a mouth-piece. For signalling purposes the operator had to blow through this tube, so as to make long or short flashes at will and thus spell out any message by the Morse alphabet.

Soon after the introduction of this flash lamp, which worked most perfectly and would doubtless have come into common use for naval purposes if it had not been superseded by electricity, I made a model lamp of very simple form in order to demonstrate the principle of these short and long

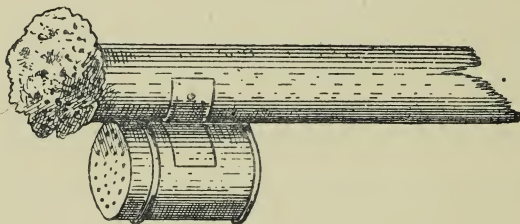


FIG. 47.

flashes at the lecture table. My flash lamp consisted of a wooden rod, two feet long, cut from a broom handle. To the top of this rod I fastened with a single French nail, a piece of sponge, and just below the top I bound on to the rod a penny tin pepper-box. The diagram of the apparatus (fig. 47) will make its construction clear. The box was charged with the flash powder, as in Captain Colomb's lamp, and the sponge was soaked in methylated spirit, squeezed, and then ignited. Holding the rod at arm's length, I then gave it a rapid sweep through the air, with the result that the powder was scattered out from the pepper-box and made

a brilliant arc of light. I believe that a torch constructed on this principle would be serviceable in photography, and I threw out the suggestion a short time back in an American photographic publication. The cost of the contrivance is next to nothing, and it will yield a flash of long or short duration, as may be required. With this reference to my rough-and-ready magnesium torch, I will close what may be termed the historical part of my subject.

The revival of the flash-light principle for photographic purposes seems to be due to Dr. Vogel, who had experimented with a certain powder prepared by Gäedicke, with which he was successful in taking portraits by night. This powder seems to have consisted of a mixture of magnesium, potassic chlorate, and antimonious sulphide. This is a needlessly dangerous mixture, which will not only explode by heat, but, like other compounds containing sulphur and chlorate, will fire with explosive violence by slight friction or percussion. Indeed, a mixture of antimony and chlorate was used in the old days for charging the percussion caps used for small arms. It is not very easy to see what use the sulphur serves in a flash-light mixture, except, perhaps, as an aid to rapid combustion. The chlorate will fire without it, especially if it have a little carbon added to it in the form of powdered loaf sugar. Dr. Piffard, whose name is associated with the revival of the flash-light system in New York, advocated, in a paper read before the Amateur Photographic Society of that city, the use of gunpowder with the magnesium, in the proportion of one volume of the former to four of the latter. I have tried this mixture with very unsatisfactory results, and am certain that most of the pow

dered metal gets blown away without ignition. The flash is certainly far from being as actinic as one would expect from the quality of magnesium employed, and the smoke given off quickly fills a large room, to the great annoyance of the dwellers therein.

Far better results can be obtained by the use of gun-cotton. The cotton should be of the explosive variety, and of such a quality that when a small tuft of it is placed on the palm of the outstretched hand and ignited, it will flash off without leaving any residue, and will fire so instantaneously that there is no burning sensation to the skin. For flash-light photography about fifteen grains of magnesium should be scattered over a tuft of cotton weighing about ten grains, which has been pulled out so as to cover the largest possible area. The cotton may be placed upon a saucer, or an old tray, and ignited with a long taper. Some have complained that the yellow colour of the flame given by the burning cotton partly neutralizes the actinic quality of that of the magnesium, but I hardly think that this contention is tangible. The cotton is simply used as a convenient means of giving the initial force to the magnesium, which it does both by scattering it in the air, and at the same time igniting it. Whatever kind of flame we use for the purposes, we may assume that to some totally inappreciable extent it may counteract by its colour the actinism of the burning metal. Still, I consider that for other reasons gun-cotton is not the best means of firing magnesium, but its simplicity will always commend it to those who only want to use the light occasionally and may not have more convenient methods readily available.

There is an unwritten law that seems to be scrupulously observed by otherwise unscrupulous traders, which runs thus—"Thou shalt commit adulteration." This law is, unhappily, of such universal application that even magnesium powder has not escaped its influence. Some of its adherents have noticed that magnesium is an expensive metal, and that zinc, which when filed to dust cannot readily be distinguished from it, is conveniently cheap. It is of course only natural that the zinc should by accident get mixed with the magnesium, and confounded with the latter. It is therefore as well that the buyer should be aware of this sophistication, and be careful to go to a trader who is above such dealings. I believe that magnesium wire and ribbon is sometimes alloyed with a small percentage of zinc, so as to correct its natural brittleness, just as our coinage is alloyed with baser metals with an equally legitimate object, but no such excuse can be pleaded for tampering with the metallic dust, which for flash-light purposes should be as pure as possible. Magnesium should be kept perfectly dry and in a well corked bottle, for it quickly tarnishes in the air, and when so tarnished it loses much of its radiant quality.

The metal magnesium, although combustible when in the form of ribbon, is when powdered not easily inflamed, the heat from a burning match being hardly sufficient to bring it to the point of incandescence. Apply a match to a little heap of the powdered metal, and as the fire sluggishly runs from particle to particle, it will feebly glow, without any sign of its wonted brilliance. But scatter the same amount of powder in a suitable flame, and we immediately have a blinding light, and something after the nature of an explo-

sion. We may, therefore, look upon powdered magnesium as being inert until its particles are separated in the air, when it at once becomes explosive.

It is only within the past quarter of a century that what are called dust explosions have been made the subject of study and experiment. Attention was first called to the matter by certain mysterious explosions by which flour and other mills had been totally wrecked, or set on fire. Enquiry soon showed that these occurrences were due to flame reaching dust-impregnated air, and experiment proved that such apparently innocuous substances as the dust from carpenters' shops, starch, sugar, buckwheat, flour, oatmeal, etc., when in a state of minute sub-division, and suspended in the air, are most dangerously explosive. It is also known that fine coal dust in dry mines has led to explosion where naked lights are used, and it is now the rule to keep dry workings artificially watered. In America, possibly because of the dryness of the atmosphere, dust explosions have been numerous, and have been attended by loss of life and great loss of property; but the instances in this country are comparatively rare. We may reasonably place magnesium among the dusts that are liable to explosion when each particle is separated from its neighbour and is surrounded by the diluted oxygen of the atmosphere.

Attempts have been made to increase the light of magnesium by burning it in an atmosphere of pure oxygen. Under such conditions the combustion is far more rapid, and the light is of a most blinding nature. But such increase of radiance is really of no photographic value, for the light given by the metal burnt in ordinary air is quite sufficient

to impress a gelatine plate. I shall presently show that far more benefit is derived from increasing the number of flashing lamps than attempting to add to the efficiency of any one point of light, and even in these days of commercially supplied oxygen, it is by no means easy, in the absence of specially contrived apparatus, to burn the metal in oxygen. It was doubtless with a view to obviate this difficulty that various flash-giving powders have been compounded in which some salt, rich in oxygen, has been associated with magnesium. All these should be regarded with suspicion—for some of them are most dangerous — and have led to fatal results. As already pointed out, chlorate of potash is a dangerous thing to handle if mixed with any compound of sulphur. But even when mixed with the magnesium alone, it forms an explosive compound of such energy that if used, in this way, only a very small portion should be fired at one time. The greatest caution should be exercised, too, in guarding the hand from proximity to the flash, for I have learnt by experience that a most painful burn can be the result of carelessness in this respect.

There is no doubt that for photographing interiors of rooms, the flash light is of very great service, and by its aid we are sometimes able to get pictures which would be difficult to obtain in any other way. It is easy enough to get a picture of a room by daylight, if we are particular to exclude that side of the apartment where the windows are. But in some cases the windows with their hangings form the most attractive part of the interior decoration, and if they are excluded the picture is lacking in interest and in

fidelity to the original. With a flash light, or for such a purpose with a slow-burning magnesium ribbon lamp, we are able to secure an image of any part of the room which we like, and we can, within certain limits, move the lamp during exposure, or, in the case of a flash-lamp, between successive exposures, and thus exert a softening effect upon the shadows. I remember that some time ago a flash-light picture was exhibited which showed what could be done by judicious arrangement of apparatus of this kind. The picture represented a suite of rooms, one leading into the other, and the last terminating in a conservatory. The rooms were richly decorated and handsomely furnished, each one being separated from the other by *portière* curtains of lace, etc. The charm of the photograph was in the perfect focus of every part, the distant conservatory being as sharply defined in outline as the nearest room. This was brought about by burning magnesium in each of the rooms in succession, and giving, besides a separate exposure for each, a special adjustment of the focussing screw.

For special purposes, such as photographing the interior of a cave or vault of large size, where smoke is not objected to, and where exposure must be of a prolonged character in order to coax detail out of dark corners, some form of pyrotechnic mixture, of which powdered magnesium forms a part, is, I think, the best thing to employ. Here is a compound which will burn well—

Saltpetre	..	..	..	..	2 ozs.
Sulphur	..	..	..	..	1 oz.
Antim. sulphide	..	..	..	..	$\frac{3}{4}$ „
Magnesium	..	..	..	..	$\frac{1}{4}$ „

This mixture should be pressed into large wooden boxes, such as are used for ointments by druggists, and the lid can be kept on until the moment when the box is required for use, when it can be fired with a slow match or touch-paper. One or two boxes of this kind will give a dazzling blaze of light for several seconds.

It is quite obvious that if we reject the plan of associating the magnesium with some explosive or inflammable compound, and use it alone, we must have some kindling flame into which it must be projected. One of the first plans suggested was to use an ordinary argand gas burner without a chimney, and by means of a central tube placed just within the ring burner, but at a slighter lower level, to blow the magnesium dust into the annular flame. It was asserted that this obviated any waste of the metal, the fact of the flame forming a wall all round it preventing any particle escaping. This I have found in practice not to be correct, for after using such an arrangement I have found particles of unconsumed magnesium lying about the room in abundance.

A far better source of heat is represented by one of those cheap little spirit stoves which can be bought for a few pence, and which consists of a pad of cotton wool, or asbestos held in a metal disc and covered over with brass wire gauze of fine mesh. This metallic pad is saturated with methylated spirit, and when a light is applied the flame given by it is both very large and very hot. Magnesium dust projected into such a fiery furnace is wholly consumed with brilliant light. There is attached to many of the flash contrivances sold a wire-covered pad of this description.

I will now point out how by the aid of one of these cheap spirit stoves or pads a very efficient flash-light apparatus can be made. Procure or make of wood or tin a box about two feet high and one foot square. The size is not of very great importance, but the box should at any rate not be smaller than the measurements given. Bore holes all round the bottom and top edge so as to provide abundant ventilation, and if the box is of wood, let the top at least be made of tin. In the true centre of the bottom of the box, as it stands on end, describe a circle which should be distinctly coloured or otherwise marked so that its place can be readily found. Upon this centre must stand the spirit stove on the little tripod which is sold with it. Immediately over it, that is in the centre of the top of the box, let there be a hole about two inches in diameter. The inside of the box, if not of bright tin, should be lined with silver paper so as to have a good reflecting surface, but the front of the box should be furnished with a frame covered with tracing cloth, which can be put in its place just before the exposure is made, and after the spirit lamp has been charged and lighted. Things being thus arranged, and the camera and sitter being ready for the exposure, the slide of the former is drawn and the lens is uncapped. Now pour sufficient magnesium powder into a perfectly dry teaspoon. Bring the teaspoon over the central hole in the top of the box, and with a glance to see that all is right, simply invert it. The magnesium is, of course, emptied direct into the flame below, with its particles widely separated, and therefore in the best condition for perfect combustion, and the result is a blinding flash of light sufficient for any ordinary exposure in a small room. The

object of the tracing cloth screen is to diffuse and soften the light, and to take away those very strong contrasts of light and shade which otherwise make themselves objectionable in this kind of work. A reflecting surface should of course be used on the other side of the figure—as in daylight portraiture in an ordinary room. This apparatus would be brought to the greatest perfection if it were furnished with a chimney by which the smoke could be carried to the open air.

An ingenious method of firing the magnesium powder in a lantern of the kind which I have described is given by an American writer. This method does away with the necessity for a spirit stove, but is only available where there is gas. It has the disadvantage of employing an explosive in the shape of potassic chlorate, but as this is not associated with any sulphur compound, it is not unsafe, provided that caution is exercised in its use. The mixture suggested is magnesium one part by measure, chlorate two parts. The chlorate should be powdered separately and mixed thoroughly with the metal, and the quantity used for one charge should not exceed sixty grains, unless under exceptional circumstances. The mixture can be fired by a long taper, but the plan given for ignition by gas is more convenient. In the lantern box is suspended a square of wire gauze, or it may be supported on the ring of a retort stand, and on this gauze, upon a square of tissue paper, is placed the charge of magnesium and chlorate. Eight inches or more below this gauze is brought a gas pipe crowned with one of those pin burners used in tobacconists' shops, which when turned up to the full make a long thin flame several inches in height. This flame

is governed by a tap within easy reach of the operator, and at the commencement of proceedings the gas is turned down to the blue. At the right moment the tap is turned fully on, and at the same time the magnesium is fired and the flash produced.

The contrivances already before the public for the production of flash-light pictures are almost as numerous as instantaneous shutters, and they present almost as much



FIG. 48.

variety as that much invented contrivance. Some of these are mere toys, and are of no use at all unless they can be fired in series. As a rule those which are of the simplest construction are the best to adopt. One or two of these I will now notice.

Messrs. Beck, of Cornhill, supply the contrivance shown at fig. 48. This consists of a glass tube with a funnel open-

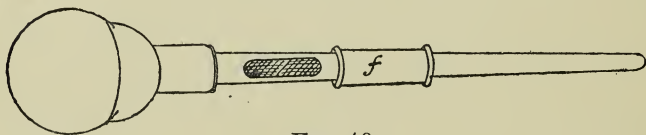


FIG. 49.

ing at the top for the admission of the magnesium powder, and a little spirit furnace in front, which is attached to the tube by a helix of wire. This is fired by the help of a pneumatic ball and tube.

Messrs. Hinton have introduced the flash-light arrangement shown at fig. 49. Here we have the same idea carried out in vulcanite, the opening for the powder being covered when the apparatus is in use, by the sliding sleeve *f*. It is evident that both these contrivances could be multiplied, and that several could be actuated by a puff of air from one source.

In Leisk's centrifugal flash lamp we have a carefully thought-out and very efficient lamp, the construction of

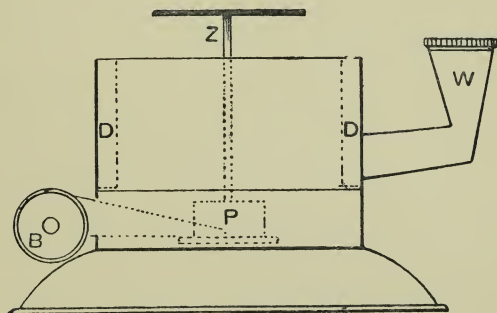


FIG. 50.

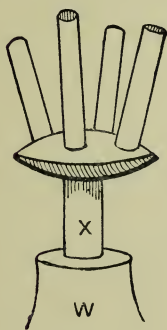
which can be understood by reference to the sectional diagram, fig. 50. The lamp is cylindrical in form, and the spirit and wick are held in an annular well, DD. The wick is of indestructible asbestos, and just enough spirit is poured into the funnel W to soak it well. When this wick is lighted, the flame forms a ring-shaped wall of fire, into which the magnesium is projected from the centre in a novel but effective manner. Z is a round table of metal, the supporting stem of which has at its base a coiled spring, P, and a horizontal

ratchet wheel, the teeth of which engage a detent which is connected with a piston B. This piston is furnished with an outlet tube to which an ordinary pneumatic ball is attached. The apparatus is set for action by giving the table Z one or two turns with the finger and thumb, so as to wind up the spring; after which a small charge of magnesium powder is scattered on the table and the annular wick is lighted. When the pneumatic ball is pressed, the detent releases the ratchet, the table spins round, and by centrifugal force scatters the powder into the wick which surrounds it, producing a large volume of light with a very quick flash.

Some of the best photographs which I have seen, and which cannot be distinguished from pictures taken by daylight, have been executed by means of a lamp, or rather by a congregation of lamps, made by Messrs. Marion—who also supply that which I have already described. These pictures were taken by the aid of four lamps, supported on the ingenious form of stand patented by Mr. Slingsby, of Lincoln. This stand can be raised or lowered to any convenient height above the sitter's head, and it is fitted with horizontal arms, which support the lamps in any desired position. In order that the lamps may all be fired at the same instant, the tube from each is connected with one pneumatic ball (W) of large size, which has a nozzle (X) like that shown at fig. 51, with quadruple nipples.

This simpler and cheaper form of lamp does not perhaps give such a mass of flame as that just described. As figure 52 shows, it follows the design of one already referred to, in which a charge of powder is projected into the centre

of an argand gas burner. Here, however, the flame, although a circular one, is produced by a spirit lamp. The spirit is contained in the small annular chamber NN, and burns at the wick K. BB is a bent pipe which has its upper orifice at a lower level than the wick, and it is charged with magnesium powder by the temporary aid of a small tin funnel before the lamp is lighted. The lower



.FIG. 51.

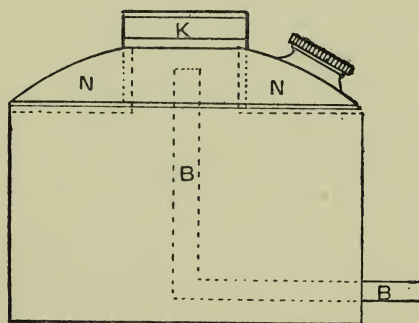


FIG. 52.

opening of the pipe B, which emerges from the side of the lamp, is connected with an india-rubber tube and pneumatic ball, and the compressed air from the latter is sufficient to propel the powder into the flame.

Some time ago I devised a cheap experimental flash light apparatus by supporting a common clay tobacco pipe in such a way that its bowl stood upright over the centre of one of the little spirit stoves already mentioned. Before lighting the spirit I put a charge of magnesium inside the bowl of the pipe, and fastened a pneumatic bulb and tube to its mouthpiece. Such an arrangement answers well, if

a pipe can be procured with sufficiently wide a bore to admit sufficient air to expel the powder. I see that a contributor to an American journal has recently still more simplified the same idea by wrapping round the bowl of such a pipe a pledget of absorbent cotton, which he soaks in spirit, so that no stove is necessary.

It must be admitted that flash-light portraits have too often a very unnatural appearance, and that the eyes in particular seem to suffer. One reason for this is that the flash is so unexpected in its brilliancy that the subject involuntarily closes his eyes at the moment of exposure, or at any rate as quickly as he can. The result is that, quick as that exposure seems, it has actually registered the image of the open eye as well as a superposed image of the closed eye. The effect is by no means pleasing, and gives a generally hazy appearance to the eye, which is apt to make the censorious ask whether before that picture was taken, the original had been dining "not wisely but too well." For this reason it is as well to direct the subject not to look at or near the source of light, nor directly towards the camera. It is always a good plan also, to make a preliminary flash without taking a photograph, so that the sitter or sitters will know what to expect, when the camera is ultimately used. Another reason why the eye suffers in these pictures is due no doubt to the circumstance that the pupil is naturally much more dilated than it is in daylight, and that the controlling muscles of the iris have not time to act when the bright flash comes. We thus photograph the eye under unusual conditions, and need not wonder that it looks unnatural. While on the subject of the eye it may be as well to point out here that

it is injudicious to subject it to the strain of these flash exposures more than is absolutely necessary. It is a wise precaution to wear a pair of smoke glasses, or those dark blue spectacles which are used by cautious electricians who have much to do with the brilliant arc-light.

There should be no difficulty in focussing for a flash-light picture if the room be lighted by gas. I am in favour of all the available gas lights being kept full on both before and during exposure, if only to prevent the sitters blinking their eyes when the flash comes, as they are likely to do when a sudden flood of light comes immediately after darkness. If there is not much light available, a candle can be held by the sitter in the same plane with his face, and its flame can be sharply focussed on the camera screen. When all is ready the slide can be drawn and the lens uncapped before the operator makes the flash, the slight preliminary exposure producing no effect upon the plate.

With regard to pose of sitter and other arrangements, let them be the same as those generally adopted for portraiture in an ordinary room, and let the magnesium lamp be regarded as a window from which the light is to come. On the other side of the figure some kind of reflecting surface must be provided, and nothing is better than a sheet, unless it be a screen made for the purpose. I have used such a screen with good effect, and it consists of a wooden frame stretched over with canvas, upon which is pasted white lining paper. The real purpose of the screen was for trying lantern pictures in a small room, so it will be seen that it answers a double purpose.

What may be called a natural background may easily be

arranged in a private room, and any number of accessories in the shape of flowers on fancy tables, Japanese screens, books and pictures are always available. Care must be taken that the strong shadow thrown by the magnesium light does not fall upon any portion of the background which will be included in the picture.

There is no particular object in taking portraits by flash-light that can be easily taken by daylight; it should be reserved for such subjects as cannot readily be obtained, in the absence of a proper studio, by more ordinary means. Children playing with pet animals, or in their night gear, or even in their bath form subjects of the kind which are attainable by flash-light. Pet animals too can be perhaps better taken by flash-light than by other means. Family groups engaged at their common amusements, gathered round the piano, playing chess, etc., will also form interesting subjects for this kind of work. The ingenious photographer will quickly think of suitable subjects, and will gladly avail himself of a means of prosecuting his favourite pursuit in the absence of daylight.

In photographing a group of persons, such as one may have the opportunity of doing at a fancy ball, or on the occasion of some private theatricals, a simple reflector is not enough, nor is one flash apparatus sufficient. The following plan will be found both convenient and effective. Employ apparatus of such a kind that a puff of air, after the kindling flame is lighted, will give the requisite flash. Let an apparatus of this kind be arranged on either side of the groups, both being at a height above the level of the sitters' heads, and let each be embraced by a sheet of tin bent into

a quarter circle. Now connect each apparatus by means of an indiarubber tube, the two tubes meeting on a T piece of quarter-inch bore which can be bought at any gasfitter's. Let the T piece lie on the floor with its still remaining open branch pointing towards the camera. Furnish this with another piece of tube long enough to reach to the back of the position occupied by the camera, and pull its further end over the nozzle of a common pair of bellows. All that now remains to be done is to light the kindling flames, see that each apparatus is charged with powder, and at the right moment give a puff with the bellows. By this means both charges will be inflamed at precisely the same moment, and the light given will be found to be quite sufficient to produce a properly exposed negative.

I have not much to say regarding the development of a flash-light picture. I am certainly in favour of using as little pyro as possible, and not stinting the ammonia. Do not be afraid of the picture appearing quickly under such circumstances. Your endeavour must be to avoid hard chalk and soot contrasts, and these you will undoubtedly get if you use much pyro and are chary with your alkali. When you find that you have plenty of detail but that there is a want of density in your negative, then is the time to add more pyro, which will gradually give your picture the density which has been lacking. In cold weather be careful to use tepid water for making up your solutions, and you will quickly find a benefit in so doing.



CHAPTER XV.

THE ELECTRIC LIGHT.



THE electric light, after many a vain effort to bring itself into prominence, has at last come within the domain of things practical, and in a short time we may hope to have it laid on to our houses much in the same way that gas has been supplied to us for so many years. It behoves us therefore to direct attention to the coming change, and to point out how far the new lamps when exchanged for old ones will possibly cause modifications and improvements in our daily work. It may also be desirable to indicate by what means and how far is it practicable for an amateur to use the electric light independently of any supply from outside his own premises. A brief review of what has been done in the past to gradually bring the electric light to its present perfection will be necessary as a prelude to my remarks.

The first experimental production of the electric light

was due to Mr., afterwards Sir Humphrey, Davy, at the beginning of this century. At that time a simple form of electric battery, founded on Volta's pile, only was known, but sufficient interest was taken in the mysterious kind of power which it exhibited to induce "a few zealous cultivators and patrons of science," as Sir Humphrey called them, to subscribe towards the construction of a powerful combination of battery cells, which, although capable of intensely brilliant results for a short time, would be stigmatised in these days as cumbrous and imperfect to the last degree. This huge battery consisted of no fewer than two thousand plates of metal—contained in porcelain cells—and exhibiting a total surface of 128,000 square inches. To the terminals of this battery were fastened copper wires, and it was when these wires, furnished with charcoal points, were brought together that the most brilliant effects were produced. Here is part of Sir Humphrey's description of the experiment: "More than half the volume of the charcoal became ignited to whiteness, and, by withdrawing the points from each other, a constant discharge took place through the heated air in a space equal at least to four inches; producing a most brilliant ascending *arch* of light, broad and conical in form in the middle. When any substance was introduced into this arch, it instantly became ignited. Platinum melted as readily in it as wax in the flame of a common candle; quartz, the sapphire, magnesia, lime, all entered into fusion; fragments of diamond, and points of charcoal and plumbago, rapidly disappeared, and seemed to evaporate in it, *even when the connection was made in a receiver exhausted by the air-pump.*"

In the above quotation there are two points which should be particularly noted, and which I have italicised. The first is the word *arch*. In Davy's experiment the two charcoal points, or rods of carbon, were held horizontally, and after being allowed to touch were separated by some inches while the so-called *arch* played between them. The arched form was doubtless due to ascending currents of air caused by the great heat, and the phenomenon is interesting as pointing to the origin of the word arc-light, which is still in common use to denote that species of electric regulator where two carbon rods are used as terminals.

The other point which I have underlined is important in indicating that the electric light is different from ordinary combustion in being quite independent of any oxygen supply. We read that when the carbon rods were placed under the exhausted receiver of an air pump, the carbon rods glowed with even greater brilliance. In the present day the little pear-shaped glow lamps, which are now becoming so common for interior illumination, depend for their efficiency on the circumstance that the delicate filament within them can shed its radiance independently of any air supply. Indeed, these little globes are exhausted of air to the greatest possible extent, and only under such circumstances will they continue to be serviceable.

From Davy's time up to within recent years many attempts have been made to bring the electric light into competition with the older illuminants, but as long as it was dependent upon the current from any form of primary battery, all rivalry, on account of the excessive cost of electricity under such conditions, was quite out of the ques-

tion. For occasional experimental use the electric light was seen now and then, and sufficient interest in it was kept up to induce inventors to produce various forms of lamps, or regulators, as they are called. These regulators act simply as supports for the two carbon pencils between which the arc light is produced, and, although they present much variety in details of construction, they have a great family resemblance. In all of them certain conditions have to be complied with, under which only can the arc light be produced. It is essential in the first place that the carbon pencils should actually touch. Directly the current passes they must spring apart for a certain distance, when between them appears the brilliant arc, which is in reality part of the current still playing between the separated carbons. Should the light be from any cause extinguished, the carbons must again come together and be separated before it can be re-established. These automatic movements of the carbon holders upon the regulators are generally brought about by the ingenious use of electro-magnets, which are controlled by the same current which furnishes energy for the light. Some regulators, and especially those of more recent introduction, are far better than others, and it must be evident to the most careless observers that the brilliant lights now in occasional use act with far more steadiness than those of a few years back. But it is only right to say that this absence of flickering is in part due to the better form of carbon pencil now in use.

Common charcoal is much too soft a form of carbon to be of any practical use for electric lighting, although it served Davy for his experimental lamp. The pioneer workers with

the light were quick to appreciate the need of something less fragile, and the recognised material for regulators came to be the harder parts of the coke found in gas retorts, which were sawn into square pencils of half-inch section. But coke is by no means a pure form of carbon, and is contaminated with certain earthy impurities, which, under the intense heat of the electric arc, would spit and sputter, and cause the light to have those irregularities in working which used to be so noticeable. When, therefore, a few years ago the electric system gave signs that at last it could compete with gas illumination, the attention of its advocates was at once turned to the improvement of the carbon pencils. The old method was discarded, and the pencils were manufactured by a process which ensured homogeneity and purity of material.

The process adopted at this time is still followed, but of course experience has induced modifications and improvements. The materials employed comprise lampblack, sugar, and other forms of carbon due to the decomposition of tar, resin, etc., which are intimately mixed, and made into a paste with gum or other binding material. This paste is formed into sticks of various sizes in iron moulds, which are subsequently exposed to a red heat until all the materials used are thoroughly coked. The product is a perfectly smooth, close-grained, and hard cylindrical pencil, which gives a metallic ring when struck. These carbons are sometimes coated with copper so as to increase their conducting power. It will be understood that these pencils are used only for what is known as the *arc-light* system of electric illumination.

But the other method of producing light by means of electricity has long had an attraction for inventors, although it cannot claim such a pedigree as that already mentioned. The *incandescent* system dates from the year 1845, when E. A. King took out a patent for a lamp which was worked upon an entirely new system. Of recent years this specification of King's has been consulted by experts perhaps more than any other document in the Patent Office, and in truth it would seem to tread heavily on the heels of certain modern inventors. The incandescent system is based upon the fact that when a thin wire of metal or carbon is placed within the circuit of a suitable battery or other source of electricity, it offers such resistance to the current that heat is generated, and it becomes incandescent. When this incandescence is brought about in a vacuum, the light given out is much increased, and the material, protected from union with the oxygen in the atmosphere, does not so soon drop to pieces. In King's first lamp he used a ribbon of platinum foil between two electrodes, but in a later form he employed a stick of carbon in a glass receiver exhausted of air.





CHAPTER XVI.

LIGHT BY INCANDESCENCE.



IT is always an interesting operation to trace the gradual evolution of any particular invention. First we have the germ, in the form of an idea which, perhaps by accident, was born of the brain of the pioneer worker ; and then we see how this infantile idea gradually grows, fostered by others, until it attains full growth and becomes serviceable to mankind. The incandescent system of electric lighting, which is even now so extensively used for interior illumination, found its germ in the patent specification of E. A. King, to which I have already referred ; and to show how like in principle this invention of 1845 is to our modern system, I annex a sketch of King's lamp, which I have copied from his specification, and I quote the description accompanying it :—

“A is a glass tube, similar to those used for barometers except that it has its upper end enlarged into a cylindrical bulb, and a stout platinum wire sealed in at the top. A binding screw is fixed on the top of the wire, whose lower

end screws in the iron piece D. To this piece the forceps F are attached, and it is connected with a similar piece at H by the porcelain rod T. The forceps G are attached to H, and clamp the lower end of the carbon piece (C), which

has its upper end held by those at F. N is a copper wire, which is fixed in the piece at H, and extends to the bottom of the tube. The tube is filled with mercury, in the same manner as a barometer, the usual precautions being taken to expel the air; its length, independent of the bulb, should be about 30 inches, so that when it is inserted in a cup of mercury a vacuum will be formed in the bulb. The instrument is included in the electric circuit by connecting one of the wires from a magnetic machine or voltaic battery with the binding screw fixed on the wire E, and the other with a wire which passes into the mercury in the cup at the bottom of the tube."

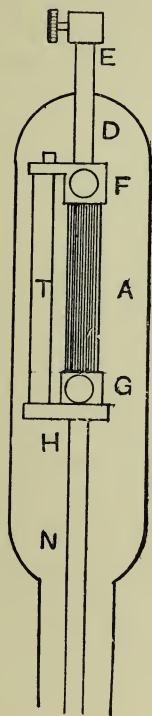


FIG. 53.

It will be seen from the above description and diagram that King's incandescent lamp is the same in principle as those of modern times. A strip of carbon is contained in a vacuum, and is brought to incandescence by the resistance which it affords to the passage of an electric current.

But the rough carbon then obtainable would at the most only hold together for a few hours, and the device to obtain a vacuum by means of a 30 inch column of mercury was

cumbrous, and expensive enough to limit the lamp to experimental uses only.

In the following year Greener and Staite patented a lamp which really represents the same idea as King's with the parts differently arranged. The mercury column also disappears, and we may presume that the inventor intended to exhaust the globe of air by means of a pump. In this design we are certainly brought nearer to the modern glow-lamp, but the thick stick of carbon which is placed between the electrodes is very different to the hair-like filament which is now used for the same purpose. Putting other considerations aside, it is certain that the comparatively large pieces of carbon used in these first lamps would require a very powerful current to bring them to an incandescent state. Greener and Staite's patent specification is worthy of further notice, because it includes sundry processes for the preparation of a finer description of carbon than that afforded by the gas retorts, and here we certainly have an important step in a forward direction.

The incandescent form of electric lighting seems to have now been put aside for a time, but in 1871 it was again revived, and strangely enough in a country which we do not usually associate with much advancement of any kind. It was in Russia that this system, in the year 1871, received what may be described as its first public trial. In this year M. Lodyghin showed two hundred incandescent lamps lighted on one circuit—the current being derived from an Alliance machine—of which more hereafter. We read that this experiment, which was successful in every way—for the short period which it covered, be it observed—made so great

a sensation that all other forms of artificial illumination were looked upon as doomed. A Company was formed, and the inventor was somewhat prematurely rewarded by a sum of 50,000 roubles from the Academy of Science. But after a short time the excitement died a natural death, and the Russians had to return once more to lamps and candles. I have no knowledge of the exact form which these lamps assumed ; but fig. 54 shows one which was invented in 1872 by Konn, another Russian.

This lamp contains a rod of graphite as the incandescent material, and the globe, instead of being exhausted of air, was "hermetically closed and filled with nitrogen, or other gas that does not support combustion."

In the description of this patent, we have evidence that the inventor was aware that the carbon was perishable, for he provides a means by which the current, when one strip of

graphite became spent, could be switched off to a second and subsequently to a third strip.

It would be tedious to quote the various lamps of this kind which have been invented and reinvented during the past twenty years. They are interesting only historically, and as links in the chain which led up to the modern glow-lamp, the gradual perfecting of which we owe to the researches of Edison, Swan, Maxim, and others.

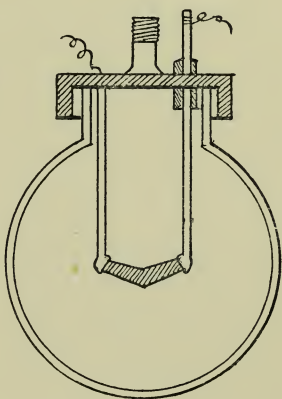


FIG. 54.

It is interesting to look back to the time, ten years ago, when the news of Edison's discovery of the glow-lamp was first made public by one of those sanguine telegrams from New York which so frightened the shareholders in our gas companies. This telegram told us that Edison had perfected an electric lamp of extraordinary simplicity, costing only twenty-five cents, and that he was going to illuminate Menlo Park by its aid; that he had discovered that a steady, brilliant light could be obtained by the incandescence of mere carbonised paper better than from any known substance. Strips of drawing paper in horseshoe form were placed in a mould and baked at a very high temperature, and their charred residuum was then attached to platinum wires which were hermetically sealed in a glass globe from which the air was exhausted. This, attached to a wooden stand, or ordinary gas fixture, was the whole lamp. About the same time as this wonderful paragraph appeared in the papers, I remember that a lamp was brought out in London and sold for one shilling. It professed to be a perfectly efficient electric lamp, and consisted of a glass tube with a small piece of carbon pencil fixed between two wires in its interior. I have no doubt that this contrivance had an enormous sale—for it appeared to be complete in itself—and was certainly cheap. The cunning inventor, however, left the purchaser to find out that attachment to some generator of electricity was necessary before it would give light. We can trace the likeness to the modern glow-lamp in the above description of Edison's 25 cent. arrangement, the most noticeable point of difference being the use of a hair-like fibre of carbonised bamboo instead of the charred card-

board. Mr. Swan, in England—whose name is familiar to every photographer—had before this used a parchmented thread for the same purpose, and this is still in use. We shall presently see how in various forms the glow-lamp is being employed for photographic purposes.

Many photographers would be very glad to adopt the electric glow lamp, on account of its cleanliness, freedom from smell, absence of danger, and other good qualities, if they only knew the best way of installing it in their dark-room without much expense. For occasional use in changing or developing plates it undoubtedly is most convenient, and there is no reason why it should not be employed for such purposes, even if we are dependent upon some form of battery for its maintenance. But the kinds of battery which are described in the text-books are legion, and it is difficult for one not well versed in the subject to choose between them. The first thing that must be understood is that one battery may be invaluable for a particular service, while it is quite unsuitable, and, indeed, useless for another. For instance, no battery is better for the ordinary electric bell, now so commonly used in houses, than the Leclanché. It will give sufficient current for a short period, but requires intervals of rest so that it may recover its original energy. This is just the treatment which it receives, the circuit being closed whenever the button is pressed, and being left open for the battery to recover itself between times. Where, on the other hand, the current must be a constant one, continuing over many hours, as in the case of electric deposition of copper, silver etc., the Leclanché form of battery would be useless, for it would soon cease to act. For this purpose we

must use a Daniell or a Smee. Where, again, we want a current of great power to produce an arc light, we must have recourse to several Bunsen or Grove cells—that is to say, if we are dependent upon primary batteries. Secondary batteries will be considered later on. But for a single incandescent lamp such as would give sufficient light for the purpose already indicated, there are certain newer forms of battery which are far more convenient in use, and which do not give off acid fumes like some of those mentioned. One in particular may be mentioned as affording effective results with little trouble and expense—I mean Schanschieff's battery. It is a single fluid battery, and the charging of it merely means the emptying out of the spent liquid, and filling it up with fresh solution. The liquid is a preparation of mercury, but its exact composition has not been published. The battery can be kept ready for use, provided that the plates are lifted out of the solution when it is idle. Its electro-motive force is constant, it gives a very steady current, and its internal resistance is small. It is durable in use, and the replenishing solution is cheap. One charge of liquid is said to maintain a 2-candle glow lamp for eight hours. The outline drawing (fig. 55) shows the various parts of one form of Schanschieff's battery with small incandescent lamp attached. This is for miners' use, but it is obvious that, with one or two slight modifications, including a red screen for the light, it would be useful in a photographer's dark-room. At any rate, the drawing will serve to indicate the positions of the battery elements, and the way in which they are raised out of the exciting liquid when the instrument is not in use.

The containing vessel A is of gutta-percha, and is divided by walls of the same material into three compartments, which form three distinct cells. The lid or top of this containing vessel, B, is made of hard wood, and fits closely into it. It has a handle, D, by which it can be readily carried about, and the glow-lamp bulb, F, is protected by a thick glass, E, which would be necessary to protect the fragile bulb from splinters of coal, etc., when the lamp was being used below ground. As there are three cells in this form of lamp, there are, of course, three sets of elements provided for them. These consist each of a stout rod of zinc; one only is visible in the drawing, and is marked Z, flanked on each side by a plate of carbon, C. One carbon plate is in each case a little narrower than its fellow, so as to accommodate itself to the triangular form of the cell in which it is placed. Returning to the upper part of the arrangement, G is a metal reflector, which half embraces the incandescent bulb, and greatly increases the light which it gives. It remains only to mention the manner in which the plates can be raised from their cells in order to throw the battery out of action. A metal vertical rod projects from the centre of the containing vessel, where the three partitions of the cells meet. It is not visible in the drawing, being hidden by the edge of one of the carbon plates. It is tapped with a screw thread at its lower part, and also at its top, so that the milled disc, H, will engage it in two different positions. One of these is where the plates are immersed in the liquid contents of the cells, and when, therefore, the lid can be securely screwed up, and the other position is that shown in

plates are at one end of a long and closed receptacle, and the mere act of inverting the arrangement puts it into action. When it is required no longer, it is again turned upside down, the liquid leaves the plates, and the light is quenched.

One of the most useful forms of battery is the bichromate, but constancy of current must not be expected from it. It is a most handy form of battery for the laboratory, for it can be put into and out of action in a second. It gives off no fumes, and the solution employed is quite inexpensive. Its most common form is that of a bottle with a vulcanite top. From this top depend the plates, two of which are carbon, and fixed, while the zinc plate slides between them, and is fastened to a brass rod which projects through the lid. The exciting fluid is a saturated solution of bichromate of potash, made with hot water, with 20 per cent. of sulphuric acid added to it when cold. The addition of the acid causes the development of much heat, and the solution must be allowed to cool before it is poured into the bottle. There are several modifications of this form of battery which may be made very useful in the photographic dark-room; and where the amateur is possessed of sufficient ability to construct apparatus for himself, this is the kind of battery which he will have no difficulty in producing without outside help.

A convenient form of dark-room lamp and battery combined is that shown at fig. 56. This apparatus is, I believe, of French origin, but can be bought in this country of numerous dealers through the wholesale house of Messrs. Perken, Son, and Rayment. The drawing must be looked

upon as being merely diagrammatic, and many unimportant parts are omitted so that the illustration shall not be unnecessarily encumbered.

The apparatus consists of a mahogany box nine inches in height and six inches square, and its outer edges are described in the cut by dotted lines. To the lower part of the lid of this box are fitted the battery plates, consisting of nine sets of three each, each three being represented by two carbons with a zinc plate between them. These plates are all connected by strips of metal, one pair of carbons being joined up with the zinc plate of the next cell, and so on throughout the series. The cells, of which only one is shown in the drawing, consist of tall glass bottles which seem at first sight to be out of all proportion to the plates which dip into them. But the reason for this apparent disproportion is to provide an excessive amount of exciting solution so that the battery shall preserve its energy for a long time without the necessity of recharging. In all bichromate, as, indeed, in most other batteries the plates should remain in the exciting solution only during the time when the battery is at work. In the bottle form of bichromate cell, the zinc is lifted out of the solution by means of a rod, and in this way all electrical action is stopped. In the apparatus which we are now considering, the plates are not lifted from the solution, but the cells and their contents are made to recede from the plates. This is brought about by a very simple arrangement of parts. The glass cells stand upon an iron platform which measures a little less than the interior width of the box, so that it will slide up and down therein with ease. It is hung upon two strong brass rods, the tops of

which are tapped and protected through the lid of the box. Collars here engage the screw thread upon

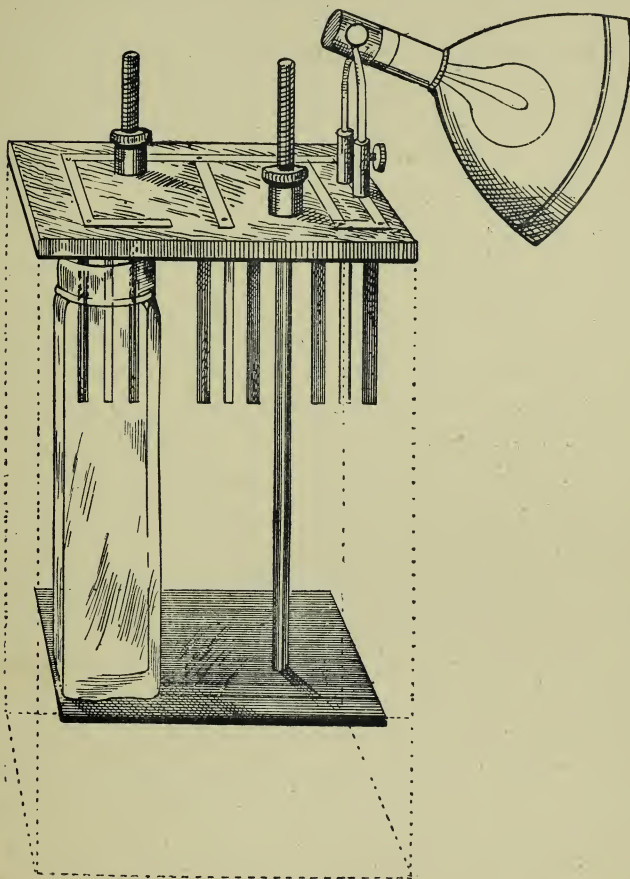


FIG 56.

each, and by simply turning these screws between the thumbs and fingers of the two hands at the same

time, the platform and the cells are raised or lowered as may be wished. It will at once be seen that this plan not only serves to put the battery in and out of action, but gives control over the amount of current afforded. For it is obvious that if the plates are only partially immersed in the liquid contents of the cell, the amount of current afforded will be in proportion. In the drawing, and for the sake of clearness, only the edges of three sets of plates are shown, but it will be understood that the square form of containing box affords room for nine. The lamp, or incandescent bulb, is contained, as shown, in a metal casing—which is silver-plated within so as to have a good reflecting surface, and which is closed in front with a disc of ruby glass. The lamp is attached to the body of the box in such a way that it can be raised or lowered as may be desirable. It is of 5-candle power, and, owing to the great capacity of the cells, it will continue active without recharging for several hours. It would be by no means an expensive form of lamp to use for such occasional purposes as the changing or examination of plates, or for development if the number of plates to be treated is not very great. The expense of recharging is not much, for a pound of bichromate, costing about 8d., and a similar quantity of acid at about a quarter that price, will last for several charges. The trouble and time is the expensive part of the process, which prevents the use of such a lamp by busy folks, but for the occasional uses which have been already indicated, it certainly is valuable.

It is, perhaps, unnecessary to caution photographers about the poisonous quality of the bichromate salt. Carbon

workers have long ago found out that some people are peculiarly susceptible to its influence, and that if they are careless in allowing a solution of it to touch their skin, and remain there, it occasions painful sores which are difficult to heal. Others seem to be able to dabble their hands continually in the red solution without suffering any harm or inconvenience. This is an instance of the presence of pachydermatous individuals among us who never feel anything, and seem to escape all the common inconveniences of life. It may be noted that the acid bichromate solution need not be thrown away after use in the battery, for it is valuable for cleaning glass vessels, and a small quantity of it should be retained for this purpose.





CHAPTER XVII.

HOW TO MAKE A CHEAP ELECTRIC BATTERY.

IN electrical matters, as in most other things, a cheap and simple arrangement of parts is often far more effective in action than one which is complex and costly. In battery cells which are made commercially there are generally brass terminals and binding screws with which to make the necessary connections. These are ornamental, convenient, and pleasant to use, but in a short time, with some descriptions of battery, and notably with the Bunsen or grove cells, the fumes from the acid employed quickly corrode the metal, and all contact points have to be kept clean by continual use of the file. If this is not attended to, the imperfect contact caused by the corrosion raises the resistance of the battery to such an extent that more than half its effective power disappears.

A convenient and simple method of joining metal wire to carbon plates without any expensive fittings has lately been patented by an officer of the Royal Engineers. It is illustrated in fig. 57. A hole is first of all bored in the carbon plate—a by no means difficult operation with a drill. The tool makes much dust, as the material is ground

away by it, and it must often be taken out of the hole during the progress of the work. It should be used dry—that is, without any kind of lubricant.

When the hole is complete, a short piece of platinum wire is thrust through it, and then bent back upon itself, as shown in the cut. No. 24 standard wire gauge is a convenient thickness of metal to use, and as short a piece as possible should be employed, on account of expense, platinum having recently, in consequence

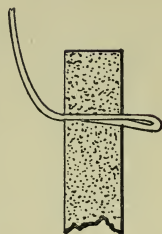


FIG. 57.

of the greediness of photographers, gone up in price about 150 per cent. Platinum is the only metal which can be used in this particular manner, on account of its stability in the presence of all kinds of acid solutions.

Another simple and convenient help to the electrical experimentalist is afforded by the little catch which is used

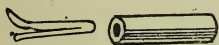


FIG. 58.

by jewellers for fastening necklaces, bracelets, etc. These can be bought by the dozen for a few pence in Hounds ditch and other thoroughfares which

seem to be given up to the requirements of the seller of cheap jewellery. I need hardly say that they are not made of gold, but of brass, but they form a very ready and convenient means of joining together temporarily wires in electrical experiments. The form of catch is shown at fig. 58, and the ends of the wire to be joined should be terminated with the two pieces of which it is formed, and they should be attached by solder. At the house of a great electrician I lately noticed that the flowers

and other decorations on the dinner-table were interspersed with glow-lamps, some of them being under water in the glass vessels, in which the flowers were placed. At first it was difficult to see how any electrical connection could be made between these lamps and the main wires below the table, without any visible break of the table-cloth. I was afterwards shown that this necessary connection was brought about by copper needles, which formed the terminals of the glow-lamp wires, and which were pricked through the cloth and were then held by these jewellers' catches or clasps.

It is not difficult to make an electric battery which shall be able to illuminate a few glow-lamps of small size, and, as already indicated, one of the most convenient for the purpose is that using a single fluid, such as the bichromate cell. Roughly speaking, a single cell, with plates, having each a surface of about eight square inches, will illuminate a glow-lamp of 2-candle power. A convenient size for the plates is 4×2 inches, and each cell will require one zinc and two carbons.

Both the carbon and the zinc plates will require some preliminary treatment before they are finally fixed to the wooden support. The carbon plates must receive a coating of paraffin wax on their upper ends, so as to prevent the battery solution creeping up by capillary attraction and corroding the metallic connections. The best way to apply the paraffin—an ordinary paraffin candle is the most handy thing to employ—is to heat the carbon plate upon the top of a stove until it is hot enough to melt the wax. The candle should then be rubbed across its upper part, after a sheet of paper has been bound round the plate, so

that its edge shall mark a boundary line. This line should be a little more than one inch from the top edge of the plate. Both sides of the carbon, as well as the edges, should be treated with the paraffin above this line, and just enough should be applied to fill in the pores on the surface, any surplus being wiped off. If too much paraffin be applied where the connecting strip of metal touches the plate, it will act as an insulator, and the current will not pass. It is therefore as well to scrape this point of junction with a blunt knife, so as to remove any wax which may have escaped the wiping process.

The zinc plate must be amalgamated with mercury, or there will be local action, which will most surely reduce the power of the cell, as well as shorten its life. To make the

mercury form an amalgam with the surface of the plate, the latter must first of all be dipped into dilute sulphuric acid, one part of acid to eight of water. The mercury may then be rubbed on to the zinc, a few globules at a time, by means of a stick, with a little flannel rolled round its end, or the vessel containing the dilute acid may have some mercury put into it, and when the zinc is placed therein the mercury will attach itself to the lower part of the plate. The zinc

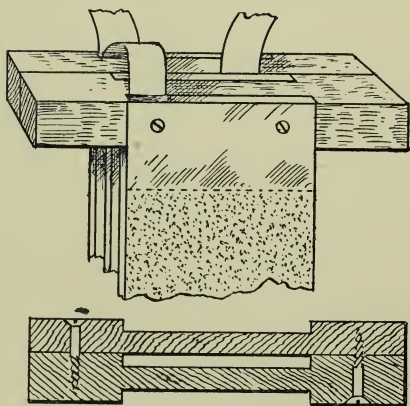


FIG. 59.

can then be removed, and placed, the other way up, against any suitable support, when the mercury will gradually run down both sides, and will amalgamate them without further

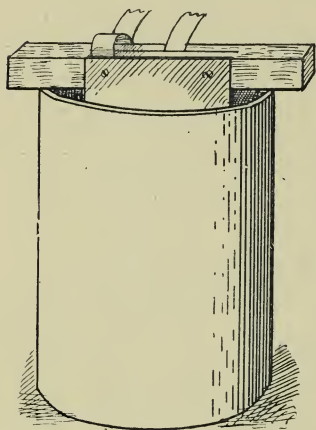


FIG. 60.

trouble. But generally a little after-manipulation with the rubber becomes necessary to persuade the mercury to cover certain spots which it is apt to leave uncoated. The top of the zinc plate should be coated with black japan, to a depth similar to that of the paraffin band on the carbons.

An elevation and horizontal section of the wooden support for the plates is shown at fig. 59 This should be of sufficient

size to project for about two inches on each side of the plates, for these projections are destined to rest on the edges of the containing vessels, as shown in the illustration of the complete cell at fig. 60. The support is made of hard wood, and is in two pieces, each of which is recessed for the reception of the plates. When they have been correctly cut and fashioned as shown, they should be heated and covered with a layer of paraffin wax. The best way is to have a bath of the melted wax of sufficient capacity to hold the wooden pieces, and to allow them to soak there for ten minutes while heat is applied to the containing vessel. When this is done, the zinc plate should be attached by short wooden pegs to the wooden piece having the double recess, while at

the same time the copper connecting strip should be inserted between the metal and the wood. Care should, however, be taken to scrape away the japan at this point, so as to afford good metallic connection between the two. The two wooden pieces may now be screwed together as shown, and the carbon plates attached to either side, not forgetting the copper bridge which connects the two, and the slip of copper which projects, and which is to serve as a connection for wires, or for other cells if more than one is to be employed.

For plates of small size the cell or containing vessel can take the form of a common glass tumbler, such as can be bought for about twopence. But most workers will prefer to employ plates of larger size than these will contain, and will use a salt-jar, such as is shown in fig. 60, for this purpose. These jars have the merit of being uniform in size and very difficult to break.

A home-made bichromate cell, like that already described, is capable of providing a current with energy enough to illuminate a glow lamp of about two-candle power. A couple of such cells will work a small induction coil, or can be put to other experimental uses, and its most convenient feature is that it can readily be put in or out of action by inserting the plates in, or removing them from the outer cell, and, of course, the same result can be brought about by pouring on or off the bichromate solution. But supposing that the cell has been in continuous action for three hours, its force will gradually decline until it ceases altogether. Upon renewal of the spent battery solution the cell will work as well as ever.

The worker, when he has made one cell, will probably

not be content until he has one more to use in conjunction with it, an addition by which he can greatly increase his resources. In this case his best plan will be to fit the cells into a stand made of two pieces of board supported one above the other, and about three inches apart, the upper board being pierced with round holes for the reception of the jars. The supports of the upper board should be in the form of two posts, eighteen inches high, which will, of course, project high above the jars. Upon these posts should slide vertically a horizontal bar, to which the battery plates are clamped in a row, in a similar manner to that already detailed in the description of the single cell. This board may be raised or lowered by means of a winch, or in any other way which the ingenuity of the maker may suggest, in order that the plates may be inserted in their respective cells or withdrawn from the same. With a battery of thirty such cells, and with plates of moderate size, I have seen a powerful arc light worked, and the same battery furnished energy—but, of course, not at the same time—to an induction coil which would give a twelve-inch spark. Those who have time on their hands and are fond of experimental work will find much interest in making a battery of this kind with which a number of instructive experiments are possible. It is clean in use, and gives off no fumes, in which respect it differs greatly from some of its congeners.

It may be as well here to point out the difference between a primary battery and a secondary or *storage* battery, for the distinction between the two is not so well understood as it might be. And in order to make this distinction clear,

it will be as well to briefly describe two contrivances which have been in experimental use for some years, and which are therefore well known to electricians.

The first to which I will call attention is the instrument known as the voltameter, by which water can be decomposed into its constituent gases, hydrogen and oxygen. The voltameter in its simplest form consists of two inverted test tubes, which are supported in a cup of acidulated water. Beneath each of these tubes, and connected with a metallic terminal upon the stand of the instrument, is a strip of platinum foil. When these terminals are joined up with a battery cell—three or four cells must be used if rapid action is desired—bubbles of gas arise from each piece of foil, and gradually displace the water in the tubes. One tube is found to fill with gas at double the rate of the other, and the former is found to contain hydrogen and the latter oxygen, thus proving that water is formed of those gases, but in the proportion of two volumes of hydrogen to one of oxygen.

Now it was discovered many years ago that, after the apparatus described had been so used, the platinum electrodes had undergone some change, by which after being disconnected with the battery employed they were able of themselves to furnish for a brief period a current of their own, as if, indeed, they had absorbed some of the electricity from the battery and could again give it up. This discovery led to the construction of Grove's gas battery, which practically consisted of a number of voltameters joined to one another, and used in conjunction like so many battery cells. With such a battery powerful effects were obtainable for a short time, but the contrivance was, from its brittle and

somewhat cumbrous character, merely of experimental importance. It required to be charged by an ordinary battery before it could yield any effects, and it must be noted that the current which it afforded was in the reverse direction to that with which it was charged. This was a true secondary battery, but, as already shown, it yielded results which were only serviceable in pointing out the way to improvement.

In 1860 Gaston Planté undertook a series of experiments with different metals which eventually led to the construction of the battery which bears his name, and which has been in occasional use since that time, as a means of obtaining a powerful current for a short period. By its aid, a surgeon, for instance, can bring a short length of wire to a red heat where it is desirable to use the actual cautery.

In most of the early forms of primary batteries the action known as polarization has presented a great difficulty, and many ingenious plans have been adopted to overcome it. Polarization is caused by bubbles of gas forming upon the battery plates, and so preventing the metallic surface from being in actual contact with the liquid contents of the cell. But in the secondary battery, it is this formation of gas bubbles that originates its peculiar action. When the metal is platinum, as in the voltameter, the plate to which the hydrogen bubbles attach themselves acts towards a clean platinum plate like zinc, or any other metal which is readily oxidised, and towards platinum which has absorbed oxygen, in a still more energetic degree.

Planté found by experiment that the best metal for his purpose was lead, and his battery consists of two long strips

of this material rolled together, but separated by flannel. This flannel was replaced at a later period by detached strips of gutta percha, which were found for many reasons more serviceable. A strip of the same metal projected from the outer edge of one of the rolled plates, and from the inner edge of the other outside the containing cell, so as to afford means for connection with the primary or charging battery. The cell, of glass, was filled with dilute sulphuric acid.

The cell as thus constructed is not yet able to furnish a current, but requires that its plates shall be "formed," as it is called. For this purpose the battery is attached to a couple of Bunsen cells, with the result that after several days, during which the current from the Bunsen battery is reversed in direction several times, the plates assume a spongy condition on their surface, and are then ready for permanent use. This was the first form of Planté battery, but the preparatory charging operation is now much hastened by roughening the surface of the plates by mechanical means, and also by giving them a preliminary bath of dilute nitric acid.

Other secondary batteries have since been devised, the most noticeable advance on Planté's original device being introduced by Faure, who discovered a means of hastening the formation of the lead plates by painting their surface with a mixture of red lead and dilute acid. The spiral form is abandoned and secondary battery cells now usually contain flat leaden plates immersed in their bath of dilute sulphuric acid. They have the fault of being cumbrous and heavy, which renders them inconvenient for certain uses. But in order to show that they are efficient

it may be pointed out that they are in use for driving electric launches, tramcars, and are commonly employed as a reserve in electric light installations.

As an instance of this latter employment of secondary batteries I may quote a case in which they were successfully used to supplement a dynamo machine. This machine, together with a large number of secondary batteries, was placed in an outhouse in the garden of a mansion near London, which was lighted throughout by electricity. Up to nine o'clock in the evening the machine furnished the current for lighting up the premises, but at that hour the engine stopped working, and without any perceptible break the secondary batteries were called into use for the remainder of the evening, giving up the energy which they had received from the machine during the daylight hours.





CHAPTER XVIII.

THE ELECTRIC LIGHT ADAPTED TO THE OPTICAL LANTERN.

WHEN the electric light is brought within easy reach by our houses and public halls being "wired," it will in the natural course of things be used for lantern projection, but only because it will be more convenient than the lime-light; not because it is better. The lime-light has, indeed, of late years been brought to such a pitch of perfection, and the best lenses, as now made, render so much of its light available, that it leaves little to be desired. Even the old complaint of bulk of apparatus can no longer be laid to its charge, now that the compressed-gas system has come into vogue. But perhaps these will be considered *de trop* when a couple of wires passed into the lantern from the house supply will afford the required amount of light.

The application of the electric light to projecting purposes is by no means a new idea, and a glance at any old text-book will show how the Duboscq arc-light regulator

was applied to this purpose more than thirty years back in connection with that extremely rough optical instrument which was known as the Solar Microscope. For nearly as

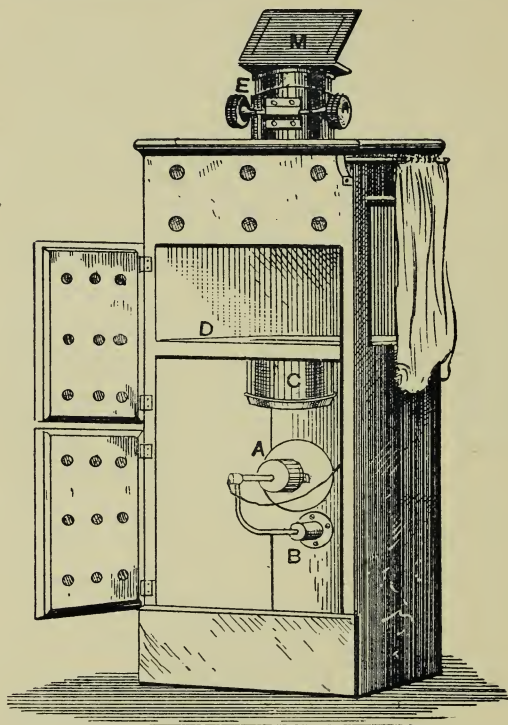


FIG. 61.

long a time the electric lamp of Serrin, and a regulator known as Browning's have been used for throwing spectrum phenomena on a screen. But such experiments were seldom shown, for the trouble, expense, and mess of a forty or fifty cell battery were not to be lightly undertaken except

by enthusiasts. An electrically lit microscope was shown at the Crystal Palace some few years back, and for a long time a lantern for ordinary lecture purposes has been in use at the large theatre of the Society of Arts in the Adelphi. This lantern gives a brilliant light, and seems to work steadily, but wants attention to keep the light spot central. It is fed by a De Meritens dynamo machine, and the regulator used is that of Siemens.

A novel and useful form of electrically lit lantern has been designed by Dr. Fleming, and is in constant use by him for class instruction at University College. The incandescent form of lamp is employed in this lantern, and as the size of the glass bulb for containing the white-hot carbon filament is inconveniently large if more than 100 candle power is required, it is obvious that this form of lantern is limited to places where only a small-sized disc is wanted. Dr. Fleming illuminates a screen of about seven feet with a 50 candle-power lamp, and he has light enough to give a disc of twelve feet. The lantern is shown in fig. 61, which is merely diagrammatic in character, and gives only the main features of the apparatus.

It consists of a well-ventilated oblong box about two feet high and ten inches square. The glow lamp A is fitted on an arm, B, which projects from the further side of the interior wall, so that the lamp is really on its side. But in the case of glow lamps position is quite immaterial. The lamp is held in its support by adjusting screws, not shown in the figure, so that it can be centred to a nicety. The silken cable from it passes to the outside of the box for ready connection with the source of electrical energy.

The lamp itself is of special construction, and has been made by the Edison and Swan Company for the purpose of lantern projection; it is shown separately at fig. 62. Apart from its great power, it differs from an ordinary glow lamp in the arrangement of its carbon filament. Instead of an elongated loop of radiance, the light is concentrated in a helix, which approaches far more nearly the theoretical point of light which is best for all optical instruments of this kind.

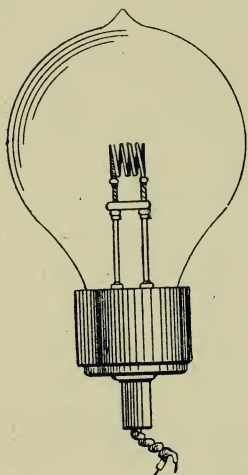


FIG. 62.

Referring once more to fig. 61, we note that a few inches above the lamp bulb is fixed the condensing lens C, on a shelf D. A curtain-covered opening gives ready access to the upper side of the shelf, on a level with which is the top surface of the condensing lens. Here is fitted a slide carrier, so that pictures can be readily exhibited, but the carrier is removable, so that experiments or preparations may be shown when desired. The image is formed by the objective lens E on the summit of the lantern, and the vertical rays are returned in a horizontal direction towards the lantern screen by the mirror M, which rests upon a collar which fits over the lens mount. A great many experiments, it may be mentioned, can be shown with a lantern, provided that there is a means for keeping the objects shown in a horizontal position, as is possible with the arrangement shown. As a

case in point, may be instanced the well-known experiment of showing curves of magnetic force by sprinkling the poles of a magnet with iron filings, where the magnet must rest on a flat surface. Various experiments with liquids are also best shown by means of a horizontal stage, and this lantern of Dr. Fleming's has adjusting screws, so that for such experiments it can be accurately levelled. The instrument is made by Mr. Steward, of the Strand, who will doubtless find a great demand for it so soon as electricity is brought into our houses as gas is now supplied.

That this is a consummation devoutly to be wished is evidenced by the rapid strides which the art of electrical illumination has taken of late years, an advance which is due to the wonderful development of the dynamo machine. When Faraday first pointed out at his lecture table that an electric current was obtainable by moving a coil of wire in front of a magnet, he made one of the most important discoveries which this century has seen, and one which has gradually brought into view the possibility of general electrical illumination. We seem to be rather backward in the matter in this country, and it has been spoken of as a reproach to us that the Americans have gone so much farther ahead. Legislation, with a view to prevent the creation of such monopolies as the gas and water companies represent, has had the effect of checking enterprise in this country, but we shall gain in the end by the delay. The Americans have not only shown us what can be done in the way of supplying a current from a central station, but they have also taught us what to avoid, and we cannot but profit by their experience. The trial of all kinds of systems and different

apparatus is bound to end in the survival of the fittest, and while our cousins have had to pay for finding out which is the fittest, we can begin where they leave off.

The incandescent lamp is, as we have seen, limited in its application to lantern work, for the reason that it is, compared with the lime-light, wanting both in intensity and in concentration; but it is quite within the bounds of possibility that some substance may be found other than carbon which will obviate these disadvantages. In the meantime, the arc system is the one to which we must look for the extreme brilliancy which is required, and absolutely necessary where a large disc is in question. The largest disc to which we can at present point as an example is that used during the photographic exhibitions which take place annually at the Crystal Palace, and which measures about thirty feet in diameter. This, although immense for most places, looks small in the large theatre in which it is placed, and there is little doubt that if a much larger one were required, no form of lime-light would give sufficient brilliancy to show the pictures effectively. It is here that the arc lamp would present such a great advantage over previously used luminants, and there are now few difficulties in the way of its use, especially in a place where the apparatus for producing the current is already installed.

Some writers have asserted that lantern pictures of a certain density are fit only for exhibition by lime-light, and that for oil lanterns they should be of a much less intense character. It has also been suggested that the electric arc lamp is of such a searching nature that slides for exhibition by it must be purposely prepared so that the image shall

be of the blackest nature. I am certain that this is altogether a mistake. A good slide will show well whatever be the nature of the light employed, and is generally best when the light is most brilliant. A good slide should be full of delicate detail, and, while of good density, should exhibit in its highest lights absolutely clear glass. Everyone knows that the less of this clear space there is in a picture, the better the effect ; but there are some processes where it is difficult to get them at all. Such slides will not show well by any light, and should be at once condemned, unless nothing better of some wanted subject is procurable.

I have already hinted that in the electric lantern used by the Society of Arts—the only one of its kind at present employed in London—there is some difficulty in keeping the light spot exactly central. I judge merely from what I noted on a recent occasion when I formed one of the audience which listened to a lecture there, and the difficulty manifested itself by an occasional shading of one side of the disc to the great detriment of the picture which happened to be shown at the time. Less critical persons would not notice, perhaps, that anything was wrong, and the exhibition generally, with that exception, was well enough. But the real test of a well-centred light is not found in its employment with the ordinary optical lantern—when a certain divergence is, as in the case quoted, allowable, if not exactly desirable. If, however, the same light were tried with a good lantern microscope, fitted with a high power, its shortcomings would be immediately accentuated, for the slight divergence noticeable in the lantern projection would become so magnified in the microscope that the image would probably disappear

with every flicker of the arc from one side of the carbons to the other.

In order to obtain the greatest amount of light from the arc lamp for projection purposes where it is necessary that the rays should strike in one direction only, particular attention should be directed to the position of the carbon pencils with regard to one another. If, as in most regulators for general lighting, the one carbon is immediately above the other, they gradually assume a shape, under the action of their own intense heat, which prevents the best results being attained. It is, of course, impossible to examine the arclight with the unprotected eye, and very little of the phenomena attending it can be seen even if the protection of smoked glass is invoked, for the glare is far too intense. But an image of the burning carbons (see fig. 63) can easily be thrown on a screen by the interposition of an objective lens, and the picture thus formed is a very beautiful one. The upper or positive carbon wastes away at double the rate of the other, and as it wastes, a cavernous opening appears at its end. The negative or lower carbon, on the other hand, preserves, as it wastes away, a pointed form. Around and between them is seen a faint luminosity of violet hue—this is, in fact, the arc itself—which gives very little radiance. The brilliance really comes from the white-hot ends of the carbon rods, and it stands to reason that if the crater in the



FIG. 63.

one reaches a certain depth, its edge must obscure a perceptible amount of the available light.

This was first discovered about twelve years ago, at the time some experiments were being carried out at the South Foreland, in order to ascertain the best disposition of the carbons for lighthouse purposes. An American Commission also at one time busied themselves with the same question, and both English and Americans reported that there is a great loss of light if, when the radiance is required in one direction only, the carbons are placed exactly one above the other. This led to the position being adopted which is shown in fig. 64, and which results in a gain of light of about 66 per cent. A still further gain is obtained by sloping the carbon rods, while at the same time the lower one is in advance of the upper one, so that the interior of the positive crater is turned towards the direction in which the light is required to stream. This idea is well carried out in a form of regulator which has many other valuable points which fit it remarkably well for projection work. To this regulator I will next direct the reader's attention.

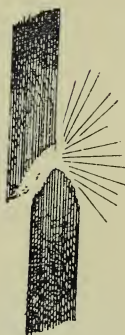


FIG. 64.





CHAPTER XIX.

THE SAME SUBJECT CONTINUED.



THE Brockie-Pell regulator, originally designed for the more general purposes of electric illumination, has been adapted to projection work by Messrs. Newton and Co., of Fleet Street. Referring to fig. 65, it will be seen that the apparatus consists of a metal box having one of its sides sloping, parallel with which are carried the carbon rods. The upper rod does not need any detailed description beyond indicating that it is set well back, so that its outer edge is in a line with the centre of the lower pencil, as in the case last dealt with. It is supported on an arm which projects from a central pillar, and which moves down as the carbon pencil wastes away, the entire arrangement being kept in position by the fixed rod *a*, upon which the moveable part slides to and fro. The lower carbon is continually pressed against a collar *c* by the action of the spring *d*, while the exact length of the arc can be regulated

by the screw *e*. *tt* are terminals where the wires conveying the current are attached.

Messrs. Newton have also devised an electric lantern of novel and ingenious form, in which this regulator is employed. It differs from the general form of optical lanterns

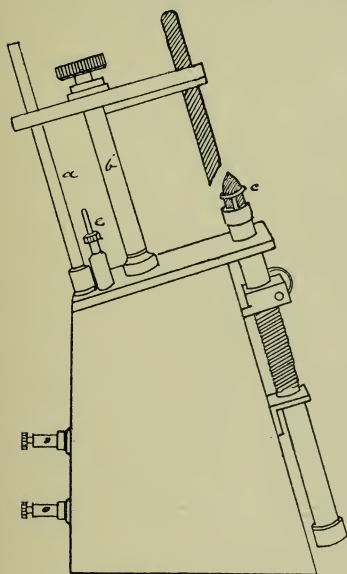


FIG. 65.

in being cylindrical, and it is wholly made of metal. The body *MM* (see fig. 66), made of Russian iron, is pierced with three main openings. One, *W*, is for the attachment of a microscope, another, *L*, is fitted with the ordinary objective for lantern projection, while the third is furnished with an adjustable slit for spectrum projection. The body of the lantern can easily be turned round so that any one of these nozzles can be brought into employment.

But for spectrum work, where the light spot must not face the screen, the entire apparatus turns upon a central pivot, the base-board being in two halves. The lower half remains fixed, while the upper one turns on its pivot until the right angle is obtained. *T* is the body of the regulator, and *EEE* are three milled-edged discs by which it can be raised or lowered, moved backward or forward, and to the right or

left respectively. By this means the spot of light can be most exactly centred. This lantern presents the most

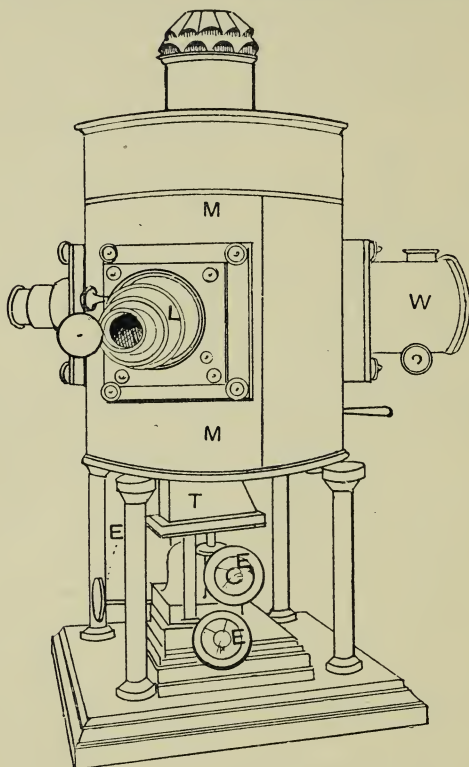


FIG. 66.

complete and perfect projection apparatus ever devised, and is designed principally for use in science schools and colleges.

It is only those who have had experience of science teaching who know the value of an experiment both to

teacher and pupil. It is often difficult to make young scholars understand the nature of an experiment from mere verbal description, even if the words be illustrated by careful drawings on the blackboard. But directly the thing is seen itself, all becomes plain sailing. The pupils take immediate interest in the matter in hand, and the master feels that they are doing so, and redoubles his efforts to make them understand aright. One feels inclined to envy the teacher who has this cylindrical lantern at his elbow with which to illustrate his remarks. At one moment he may want to show a few diagrams, which possibly have been prepared for him as lantern slides by the senior pupils; next he may desire to illustrate the structure of some organism by means of the microscope, and the instrument is at once ready for use. The great advantage gained in the use of a lantern microscope for class teaching can hardly be realised except by those who have seen a large histological class at work at one of our hospital schools, each member of which has a microscope before him, and is peering into it as the teacher does his best to describe what each *ought* to see. Now it is obvious that each student is looking at a different slide, and although these slides will have features in common, they cannot all be the same. But in the case of the lantern microscope, each student has his attention directed to the enlarged image of the same object, and the teacher can with his pointer show the well-marked peculiarities of the subject. The spectroscope can as readily be brought into use as the two other nozzles of the electric lantern, and thus the teacher has a very wide range of experimental help within his reach. Under other conditions,

an experiment would often be carefully shunned, on account of the expense and trouble involved in its preparation and demonstration.

Mr. G. M. Hopkins describes, in his admirable work "Experimental Science," an adaptation of the Jablochkoff candle to projection purposes. It will be remembered that the so-called candle made a sensation when first introduced in this country, for it was looked upon as a simple and efficient device for doing away with all the mechanism and consequent expense of regulators. For some years the Thames Embankment was lighted by these candles, and the effect was very beautiful, but the expense of maintenance was too great, and the lights were discontinued. In the "candle" the carbons are placed side by side, but are separated and insulated from one another by a thin wall of plaster, which is consumed as the two carbons gradually waste away. As this waste must be equal, the candles can only be used with a dynamo machine which gives an alternating current, that is to say, a current which changes its direction continually.

For projection work Mr. Hopkins employs this candle in a horizontal position, so that its luminous end is presented towards the condenser of the lantern, and its radiance is concentrated at this spot by an ingenious device. This consists of a helix of wire placed around the end of the candle, through which the same current which supplies the light is caused to flow, with the result that the arc is attracted towards the ring or helix, in opposition to its tendency to follow the direction of the carbon rods. The horizontal "candle" slides in a suitable support, and can be kept at the correct distance from the condenser by manipulating an

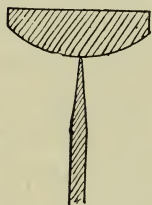
ebonite handle at the further end. As the Jablochhoff candle consumes at the rate of about ten inches an hour, it is obvious that its use in the lantern must be confined to experimental purposes. One very serious defect it has, which is this: if from any cause the light is quenched, it will not recover itself automatically—the two ends of the carbons must be touched with some conducting medium before the arc can be re-established.

This consideration led, some few months after the introduction of the electric candle, to a modification by M. Rapieff. He placed the carbons side by side, as in the Jablochhoff arrangement, but dispensed with the separating wall of plaster, and substituted for it a wall of air. The carbons were set in two sockets about three-eighths of an inch apart, and if the light was extinguished their ends fell together, and immediately sprang apart again when the arc was established. This plan could readily be adapted to lantern purposes, but the fault of quick consumption would still remain uncorrected.

Some years ago a system which was at the time regarded as novel, and from which great results were anticipated, was exhibited in London. It was known as the Werdermann method of electric lighting, and its most noticeable feature was that it combined in one light the principle of the arc and incandescent systems. It might be correctly described, in fact, as an incandescent pencil of carbon, round which was developed an arc light. It was really founded upon a previous invention by Reynier, whose intention it was to combine the two systems as far as it was possible to do so. To this end he arranged the two carbons in an

entirely new manner, making the lower one of large size, and giving it a fixed position, while the upper one, in the form of an extremely narrow pencil, less than a quarter of an inch in diameter, rested upon it and pressed upon it with the force derived from a heavy holder. As the thin carbon was practically consumed at the point of contact, it advanced, owing to the downward pressure of the holder with which it was associated, but at the same time a considerable amount of ash accumulated. To get rid of this difficulty, Reynier caused the lower carbon block to revolve so that the ashes fell away as fast as they were generated. This rotary movement, of course, involved a train of clock-work, or other convenient mechanism, and at once the "sweet simplicity" of the contrivance disappeared.

In Werdermann's lamp this difficulty with regard to the accumulation of ashes was met in another way. He reversed the positions of the two carbons, placing the larger one uppermost, and forcing the narrow pencil which the other presented upwards against it by the action of a counterweight. The position and form of the two carbons is



shown in the annexed figure. The upper carbon is in shape like a pastrycook's bun, and it was held in position by a curved arm. The lower carbon worked in a tube, like a spring candle in its socket, only that the force which drove it upwards as it was gradually consumed was a weight. The

FIG. 67. ashes as they were formed fell away by gravity, and they were almost entirely due to the wasting of the lower carbon, the heavy block above showing little

trace of deterioration after several hours, burning. The Werdermann lamp never, I believe, got beyond the experimental form; the reason probably being that it required a wasteful amount of electrical energy for its support. But it certainly had merit in preserving the point of radiance in one fixed position, and I have always thought that in a modified form it might for this reason be well adapted for lantern projection, although it failed to meet the requirements necessary in a lamp for general use.

The Werdermann principle seems to have been lately revived in the Russell arc lamp, which was recently brought forward in America, and which I believe has already made its *début* in this country. The Russell lamp is said to burn twice as long as an ordinary arc lamp without retrimming or any other attention. The upper carbon is in the form of a disc, the edge of which is presented towards the pencil which forms the lower electrode. This disc slowly revolves, so that at every revolution there is a certain amount burnt off its edge; provision is therefore made for slightly lowering the disc as a whole at each revolution. The action continues in this way until the disc is almost entirely consumed. The Russell lamp will burn for eighteen hours, and by a slight modification of parts can be made to last for twenty-four hours at a stretch, and the cost of the carbons, weight for weight, is less than under the usual system of similar rods for positive and negative electrodes. The light being perfectly stationary, this form of lamp would seem to be specially adapted to that class of work where the point of radiance must be kept in unision with the centre of an optical system.

Werdermann published the results of many interesting experiments which he made in using carbons of different sizes in connection with one another, and showed that their shapes altered under the action of the electric current. The form of lamp which he ultimately adopted was founded on the following observation, which may be given in his own words:—"When the sections of the electrodes are nearly as 1 to 64, and they have been placed in contact, no light is any longer given off by the positive electrode [this is the upper one in the annexed cut]. The negative one alone produces the light. It is curious that when a voltaic arc is set up between the two carbons, the smaller electrode is always shaped into a point, whether it be positive or negative."

Some time ago I arranged a modified form of Werdermann lamp for lecture-table demonstration, and I have always found it to act with extreme steadiness and brilliance. The upper carbon is of the shape already described, and is fixed upon an arm which projects from an upright supporting pillar. Upon the same vertical support, but lower down, is placed a lever arm, which holds in a clip the lower carbon (pencil), and which has at its free end a sliding weight, the position of which is governed by the amount of current at disposal. From experiments I have made, I feel confident that this form of lamp, if modified, to some extent would be serviceable for lantern work. One modification would be the sloping position of the lower carbon rod, which has already been illustrated in the Brockie-Pell form of regulator.

I have not in these chapters dwelt in detail upon the

application of the electric light to studio work, because at the present time such an application is beyond the reach of the ordinary amateur. The arrangement generally adopted is to place a simple form of arc regulator in a large whitened concave reflector above the sitter's head, the direct rays being stopped by a shade. This reflector is moveable, so that its position can be shifted during the brief exposure necessary. It is within the power of any one resident in London to see the arrangement for himself by patronising one of the studios where the system is in use.





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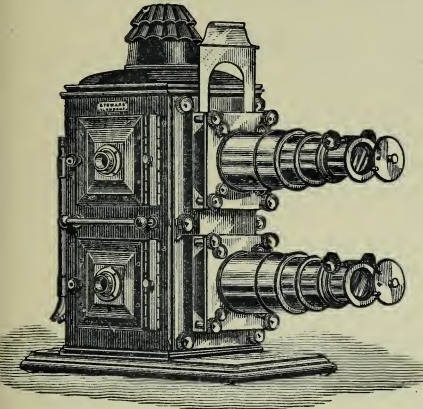
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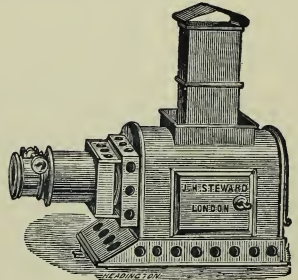
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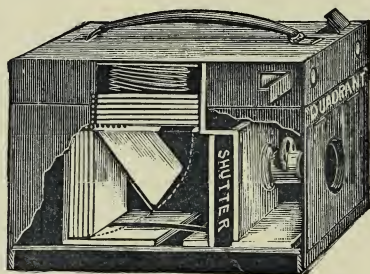
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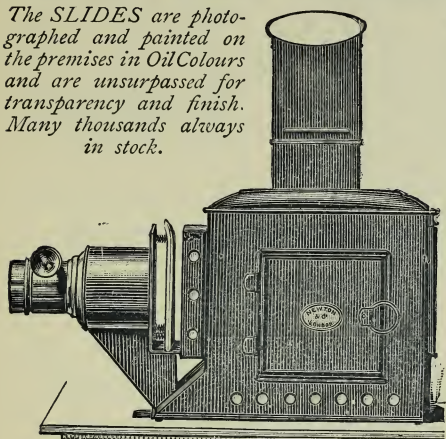
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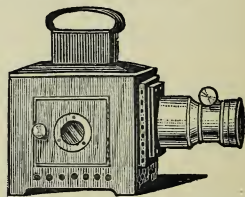
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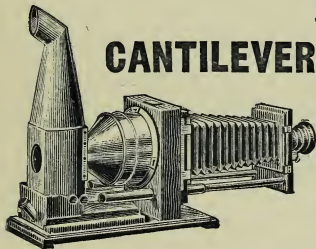
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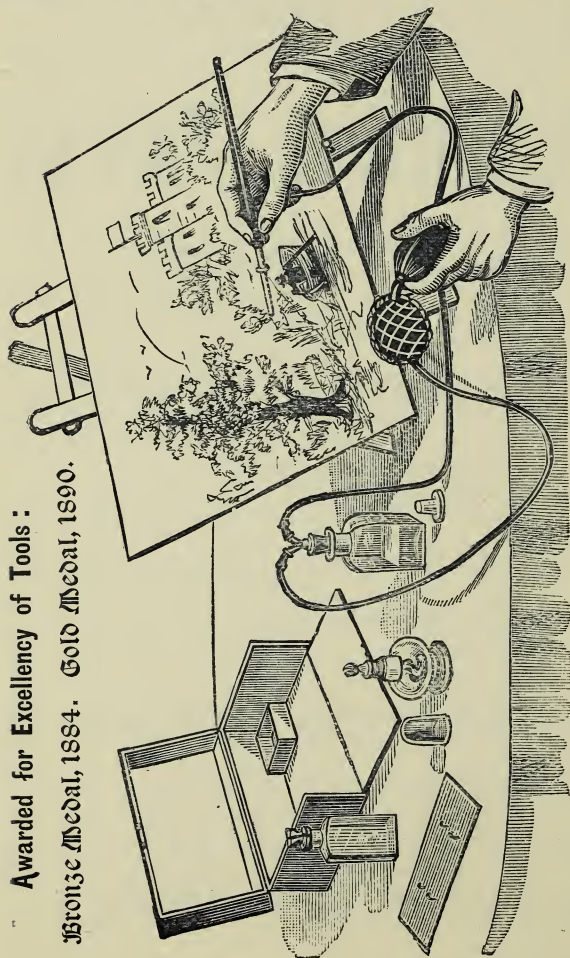
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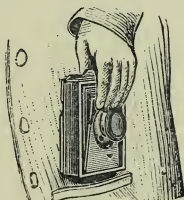
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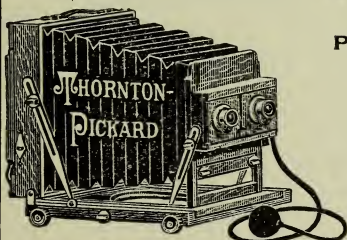
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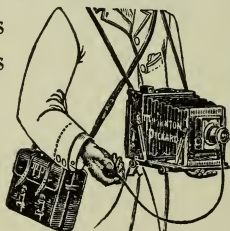


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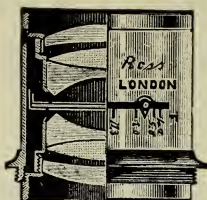
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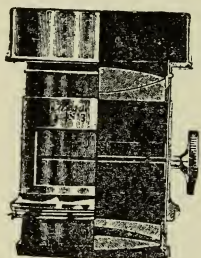
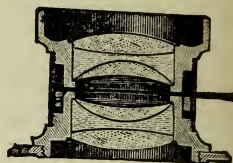
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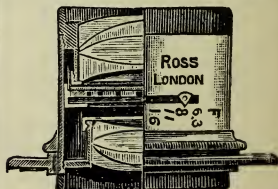
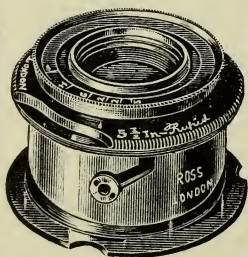
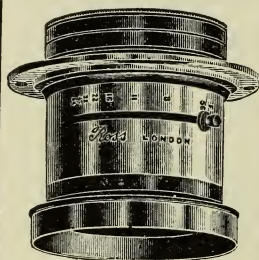
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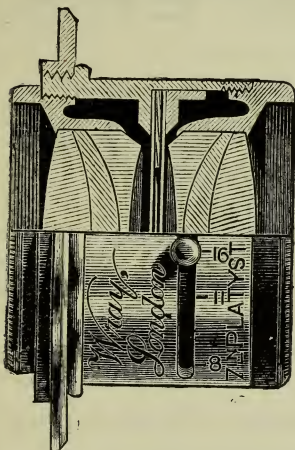
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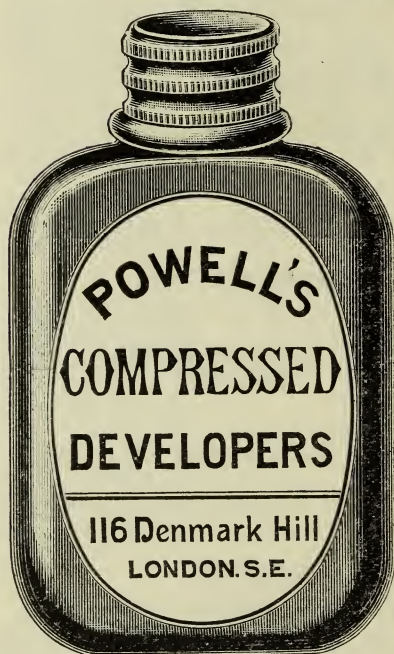
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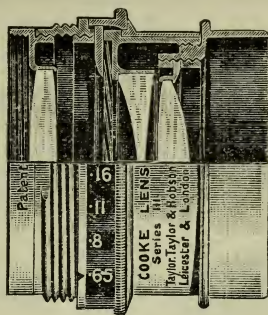
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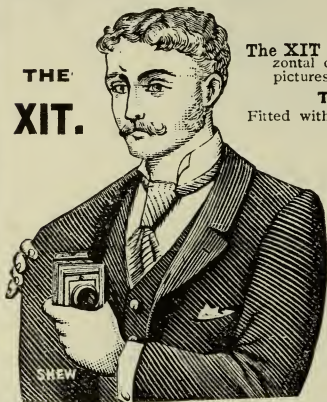
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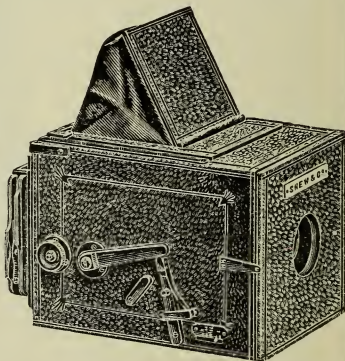
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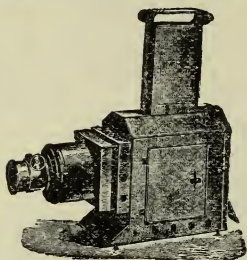
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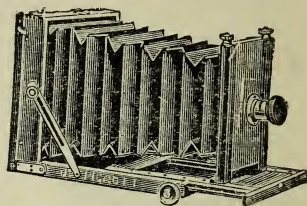
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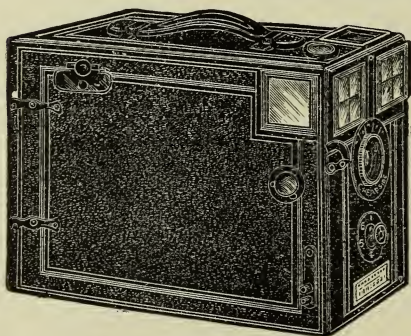
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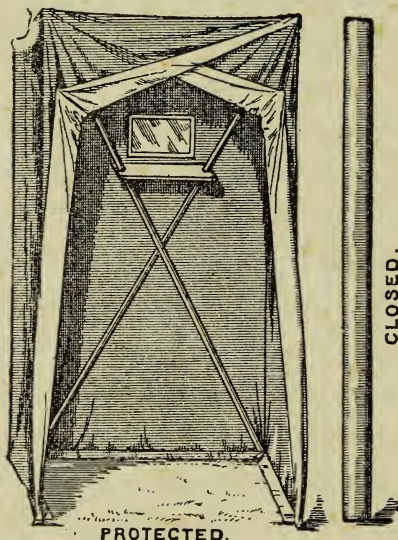
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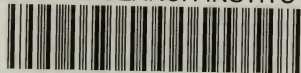
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